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OPERATION AND SERVICE MANUAL

MODELS
431A, 432A, 433A, 434A, 435A,
436A, 438A, 442A, 444A,
and 435A/4309A RF UNITS

WEINSCHEL ENGINEERING CO., INC.
ONE WEINSCHEL LANE
GAITHERSBURG, MD 20877



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MODELS
431A, 432A, 433A, 434A, 435A, 436A, 438A, 442A, 444A, and 435A/4309A RF UNITS

IM-101

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SECTION 1

GENERAL INFORMATION

1.1 INTRODUCTION

This manual contains information necessary for operating and servicing the RF Units used with the Model 430A Sweep Oscillator. A general description, installation information, operating instructions, principles of operation and maintenance information are provided. A complete set of schematic diagrams is also provided to aid in understanding the various modes of operation and for proper servicing of the equipment.

1.2 DESCRIPTION

The RF Units for the Weinschel Engineering Model 430A Microwave Sweep Oscillator are listed in Table 1-1 which shows the frequency range of each unit (all but the Model 437A are covered by this manual). These RF Units contain a frequency source, its regulated supply and other related circuits such as levelers, step attenuators, etc. Once installed in the front panel compartment of the Model 430A Sweep Oscillator, the RF Unit is an integral part of the oscillator circuitry. All standard RF Units provide external leveling capabilities; internal leveling and other options are available as indicated in paragraph 1.3.

The RF Units described in this manual are identical to the RF Units supplied in the Weinschel Engineering Model 4310A/K Multiband Sweeper System, except those specific RF Units do not contain a PIN diode modulator in the RF output circuit and are therefore designated with a -2 suffix number to the standard model number.

Figure 1-1 shows some of the RF Units listed in Table 1-1. A Model 430A/RF Unit combination is shown in Figure 1-2. Specifications for each RF Unit are provided in Table 1-2. A comparison of available power from standard RF Units to those with various options is given in Table 1-3.

A single band sweep oscillator is achieved by using the Model 430A and one plug-in RF Unit. To provide multiband operation with a continuous sweep output, the following additional accessory units are required:

	Two or more RF Units
Manually Controlled and not Multiplexed	Model 4301A RF Unit Holder (for operation over five or more octave bands). Each Model 4301A will hold only two RF Units.
	Model 4302A RF Unit Controller (used in conjunction with Model 4301A) will control up to and including six RF units.

TABLE 1-1 PLUG-IN RF UNITS

Weinschel Engineering Model No.	Frequency Range (GHz)
431A-1 & 431AP-1	1 to 2
432A & 432AP	2 to 4
433AH & 433AP	4 to 8
434AH & 434AP	8 to 12.4
435AH & 435AP	12.4 to 18
436A	18 to 26.5
437A*	26.5 to 40
438A-1 & 438AP-1	0.01 to 2
442A	1.7 to 4.2
444A	10 to 15

*Separate Operation and Service Manual Available.

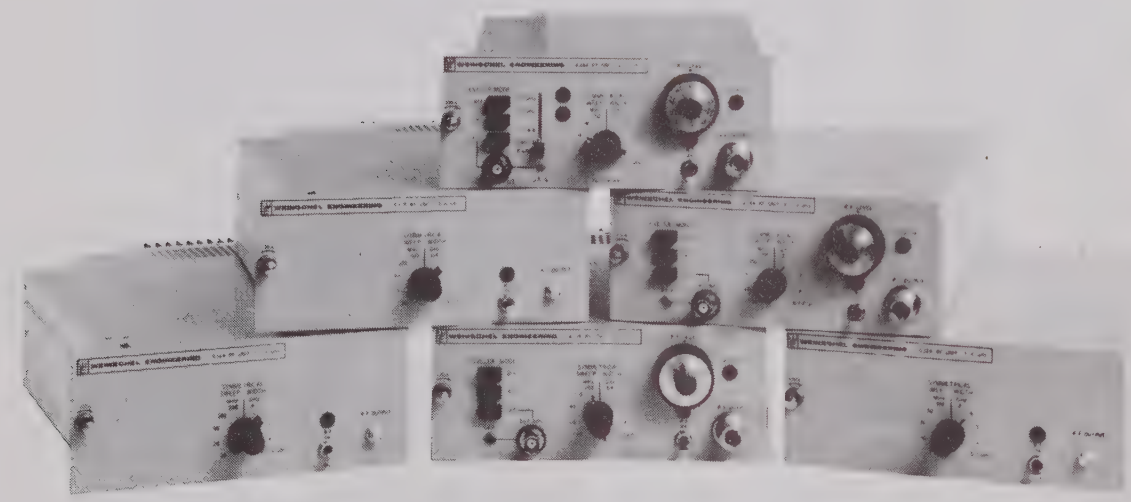


Figure 1-1. Some of the Model 430A plug-in RF Units available

TABLE 1-2. SPECIFICATIONS

SPECIFICATIONS	STANDARD HIGH POWER									SUPER POWER					
MODEL No. (Installed in Mainframe)	438A-1	431A-1	432A	433AH	434AH	435AH	436AH	442AH	444AH	438AP-1	431AP-1	432AP	433AP	434AP	435AP
FREQUENCY Range (GHz)	0.01-2	1.0-2.0	2.0-4.0	4.0-8.0	8.0-12.4	12.4-18.0	18-26.5	1.7-4.2	10-15	0.01-2	1.0-2.0	2.0-4.0	4.0-8.0	8.0-12.4	12.4-18.0
Accuracy (at 25°C)[1] (all modes):	0.01-1 GHz: ±10 MHz 1-2 GHz: ±0.5% 0.01-2 GHz:[2]	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	0.01-1 GHz: ±10 MHz 1-2 GHz: ±0.5% 0.01-2 GHz:[2]	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%
Stability: With Temperature: (MHz/°C) With 10% Change in Line Voltage: (kHz) With Full Range (30 dB) Change in Power Level: (MHz) With 3: 1 Load VSWR (All Phases):	<0.2 <10 <1 MHz (1-2 GHz) <3 MHz (0.1-1 GHz) <1	<0.2 <10 <1 <1	<0.4 <20 <1 <1	<0.5 <30 <1 <1	<1.4 <40 <1 <1	<3.0 <60 <2 <2	<8.0 <600 <6[11] <8	<0.4 <20 <1 <1	<2 <50 <2 <2	<0.2 <10 <1 MHz (1-2 GHz) <3 MHz (0.1-1 GHz) <1	<0.2 <10 <1 <1	<0.4 <20 <1 <1	<3 <30 <1 <1	<1.4 <40 <1 <1	<3 <60 <2 <2
RF OUTPUT SIGNAL Minimum Leveled Power (at 25°C)(mW): Minimum Unleveled Power (at 25°C)(mW):	15 –	15 –	15 –	10 –	10 –	10 –	– >4[10]	15 –	10 –	30 –	30 38[10]	30 38[10]	30 40[10]	25 30[10]	20 27[10]
Leveled Power Control Range: (dB)	>15[9]	>15	>15	>15	>15	>15	>10	>15	>15	>15	>15	>15	>15	>15	>15
Power Variation Internal Leveling: (Opt-1) (dB) External Leveling[3]: (dB)	±0.7[8] ±0.1	±0.5 ±0.1	±0.5 ±0.1	±0.5 ±0.1	±0.7 ±0.1	±1 ±0.1	N/A ±0.1	±0.5 ±0.1	±0.7 ±0.1	±0.5 ±0.1	±0.3 ±0.1	±0.4 ±0.1	±0.5 ±0.1	±0.5 ±0.1	±0.7 ±0.1
Spurious Signal Rejection: Harmonics: (dB_c) Non-Harmonics: (dB_c)	>20[12] 0.01-1 GHz: >30[4] 1-2 GHz: >60	>20 >60	>20 >60	>20 >60	>30 >60	>30 >60	>30 >60	>20 >60	>30 >60	>20[12] 0.01-1 GHz: >30[4] 1-2 GHz: >60	>20 >60	>20 >60	>20 >60	>30 >60	>30 >60
Peak Residual FM: (KHz)	<5	<5	<7	<10	<12	<25	<35	<7	<20	<5	<5	<7	<10	<12	<25
Residual AM:	>50 dB_c	>50 dB_c	>50 dB_c	>50 dB_c	>50 dB_c	>50 dB_c	>50 dB_c	>50 dB_c	>50 dB_c	>50	>50	>50	>50	>50	>50
Output Connector Type:	N female	N female	N female	N female	N female	WPM[5,6] female	WPM-3[13]	N female	N female	N female	N female	N female	N female	N female	WPM[5,6] female
MODULATION AM Input: Leveled Mode: Rise and Fall Time: Frequency Response: Modulation Sensitivity[7]:	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt	<2.3 µsec >150 kHz ≈2 dB/volt
On/Off Ratio:	>40 dB	>40 dB	>40 dB	>40 dB	>40 dB	>40 dB	>30 dB	>40 dB	>40 dB	>40 dB	>40 dB	>40 dB	>40 dB	>40 dB	>40 dB
FM Input or Phase Lock: ±2 dB Frequency Response: For ±20 MHz Deviation: For 100% of Band:	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz	DC-100 kHz DC-1 kHz
Modulation Sensitivity (Nominal): (MHz/Volt)	10	10	20	40	44	56	85	25	50	10	10	20	40	44	56
High Speed Pulse Input: Option 03 Rise/Fall Time:	Not Applicable	<50 nsec	<50 nsec	<50 nsec	<50 nsec	<50 nsec	N/A	<50 nsec	<50 nsec	Not Applicable	<50 nsec	<50 nsec	<50 nsec	<50 nsec	<50 nsec
On/Off Ratio (dB)	Not Applicable	>40	>40	>40	>40	>40	>30	>40	>40	Not Applicable	>40	>40	>40	>40	>40
OUTPUT STEP ATTENUATOR - Option B (0-90 dB in 10-dB Steps) 0 Position Insertion Loss (dB) Leveling Deviation w/ Attenuator in 0 dB Position	0.6 ±0.8	0.6 ±0.8	0.6 ±0.8	0.8 ±1.0	1.0 ±1.2	1.5 ±1.5	N/A N/A	0.6 ±0.8	1.2 ±1.3	0.5 ±0.6	0.6 ±0.6	0.6 ±0.7	0.8 ±1.0	1.0 ±1.1	1.5 ±1.2
DIGITAL FREQUENCY PROGRAMMING - Opt 10 16 Line BCD and Option 08 IEEE 488 Interface Bus, 10,000 Point Frequency Resolution (Bit/MHz)	0.1	0.1	0.2	0.6	0.6	0.6	0.9	0.2	0.6	0.1	0.1	0.2	0.6	0.6	0.6

NOTES:

(1) After 10 minute warmup.
(2) 10 MHz ±1%
(3) Excluding External Directional Variations.
(4) >25 dB_c from 10 MHz to 150 MHz
(5) Mates with SMA.
(6) Waveguide output optional. Contact factory.
(7) Positive going Signal increases RF Output Power.
(8) Single band only.
(9) Tracking range in wideband Typ > 10 dB
(10) For units without internal leveling.
(11) For 10 dB change in power level.
(12) At specified leveled power.
(13) Mates nondestructively and resonance free with certain SMA connectors.



Figure 1-2. Weinschel Engineering Model 430A Sweep Oscillator with a Model 435A RF Unit Installed

Electronically Controlled and Multiplexed

- Model 4309A Interface Unit or 435A/4309A for systems extending to 18 GHz.
- Model 4310A/K Multiband Control Unit

Each RF Unit is furnished with its own frequency scale. These scales are attached to the Model 430A and are keyed to each Model RF Unit to ensure accurate frequency positioning.

1.3 AVAILABLE OPTIONS

The Model 430A series of RF Units are available with a variety of options as described below:

a. -1: Internal leveling, including directional coupler and RF power detector. With an external directional coupler and detector, the internal feed back amplifier maintains output power variation to within ± 0.05 dB plus coupler and detector variation. (Not available for the 435A/4309A.)

b. -B: Includes 0-90 dB manual step attenuator calibrated in 10 dB steps with an uncalibrated vernier covering a minimum range of 13 dB, providing a total attenuation range of greater than 103 dB. The -1 option is included as part of this option.

c. -R: Rear panel output connector.

d. -03: High speed pulse modulation. Less than 50 nsec rise and fall time (1-18 GHz) ±5v input turns on RF and 0 volts turns off, TTL/DTL logic compatible.

e. AP: Super power version of RF Units operating up to 18 GHz. See Specifications for specific minimum power levels.

f. -2: RF Unit configuration specifically for use in a Model 4310A/K Multiband System. Option -2 RF Units will not contain -B option (including internal leveling) and **do not** contain front panel LEVELER MODE switches. This is applicable to all RF Units except Models 431A and 438A.

TABLE 1-3 RF OUTPUT SIGNAL SPECIFICATION

	MODEL 431A-1	MODEL 432A-1	MODEL 433A-1	MODEL 434A-1	MODEL 435A-1	MODEL 438A-1	MODEL 442A-1	MODEL 444A-1
MLP	15 mW	15 mW	5 mW	6 mW	4 mW	15 mW	15 mW	X
LPV	±0.5 dB	±0.5 dB	±0.5 dB	±0.7 dB	±1.0 dB	±0.7 dB	±0.5 dB	
MLP-LPV	13.5 mW	13.5 mW	4.5 mW	5.1 mW	3.2 mW	12.9 mW	13.5 mW	
	431AH	**432AH**	**433AH-1**	**434AH-1**	**435AH-1**	**438AH**	**442AH**	**444AH**
MLP	X	X	10 mW	10 mW	10 mW	X	X	10 mW
LPV			±0.5 dB	±0.7 dB	±1.0 dB			7 dB
MLP-LPV			8.9 mW	8.5 mW	7.9 mW			8.5 mW
	431AP-1	**432AP-1**	**433AP-1**	**434AP-1**	**435AP-1**	**438AP-1**	**442AP**	**444AP**
MLP	30 mW	30 mW	30 mW	25 mW	20 mW	30 mW	X	X
LPV	±0.3 dB	±0.4 dB	±0.5 dB	±0.5 dB	±0.7 dB	±0.5 dB		
MLP-LPV	28.0 mW	27.4 mW	26.9 mW	22.3 mW	17 mW	26.9 mW		
	431AB	**432AB**	**433AB**	**434AB**	**435AB**	**438AB**	**442AB**	**444AB**
MLP	13.5 mW	13.5 mW	4.4 mW	5.1 mW	3.2 mW	13.5 mW	13.5 mW	X
LPV	±0.7 dB	±0.7 dB	±0.7 dB	±1.0 dB	±1.4 dB	±0.9 dB	+0.7 dB	
MLP-LPV	11.5 mW	11.5 mW	3.7 mW	4.1 mW	2.3 mW	11 mW	11.5 mW	
	431AHB	**432AHB**	**433AHB**	**434AHB**	**435AHB**	**438AHB**	**442AHB**	**444AHB**
MLP	X	X	8.7 mW	8.5 mW	7.9 mW	X	X	X
LPV			±0.7 dB	±1.0 dB	±1.4 dB			
MLP-LPV			7.4 mW	6.8 mW	5.8 mW			
	431APB	**432APB**	**433APB**	**434APB**	**435APB**	**438APB**	**442APB**	**444APB**
MLP	26.7 mW	26.7 mW	26.1 mW	21.3 mW	15.9 mW	35.7 mW	X	X
LPV	±0.5 dB	±0.6 dB	±0.7 dB	±0.8 dB	±1.1 dB	±0.8 dB		
MLP-LPV	23.8 mW	23.3 mW	22.7 mW	17.7 mW	12.3 mW	29.7 mW		
Step Loss	0.7 dB	0.7 dB	0.7 dB	1.0 dB	1.4 dB	0.9 dB	0.7 dB	

NOTES:

MLP Minimum Leveled Power (at 25°):
LPV Power Variation, Internal Leveling:
MLP-LPV Minimum Leveled Power including Leveled Power Variation:

SECTION 2

INSTALLATION

2.1 GENERAL

The Weinschel Engineering Model 430A Series of RF Units are shipped, with the applicable frequency scale, in a double carton and is cushioned between molded in place plastic pads. Do not destroy the cartons or packing material until the equipment is thoroughly inspected. If damage is found, notify the carrier immediately and do not destroy any packing material until an agent of the carrier has examined it. Under U.S. shipping regulations, damage claims must be collected by the consignee; do not return the instrument to Weinschel Engineering until a claim for damages has been established.

2.2 INSTALLING RF UNIT IN MODEL 430A MAINFRAME

CAUTION

Ensure that the fan on the rear of the Model 430A Mainframe is installed and operational when an RF Unit is used. Otherwise, serious damage may occur within the unit.

If another RF Unit is to be removed from the mainframe first, proceed as follows:

1. Turn off power (via the PUSH ON switch).
2. Unfasten and remove the frequency scale from the mainframe by loosening the two knurled screws.
3. Rotate the knurled LOCK knob on the RF Unit front panel counterclockwise. Draw the RF Unit out of the mainframe by pulling on the LOCK thumbscrew.

Then, install the new RF Unit as follows:

1. Place the new frequency scale (furnished with the RF Unit) on the mainframe and fasten it by its two thumbscrews.
2. Rotate the knurled LOCK knob on the RF Unit front panel counterclockwise. Insert the RF Unit into its compartment within the mainframe until its front panel is flush with the mainframe panel.
3. Rotate the knurled knob fully clockwise.
4. Power may now be turned on. The equipment is ready for operation immediately.

2.3 OPERATING TEMPERATURE RANGE

The RF Unit together with the Model 430A is designed to operate within its specifications when the ambient temperature is between −10°C and +40°C. Operating in ambient temperatures beyond these limits could affect the accuracy of the instrument and cause damage to its circuits.

2.4 REPACKING FOR SHIPMENT

To protect the unit during reshipment always use the best packing methods available. When possible, use the original packing containers and cushioning material. Make certain the plug-in RF Unit is securely locked in position and held there by cushioning material if installed in the Model 430A during shipment. If the original packing materials are not available, use the following procedure:

1. Wrap instrument in sturdy paper or plastic.
2. Place wrapped instrument in a strong shipping container; use a 3/4-inch layer of shock absorbing material around all sides of the unit to provide a firm cushion and prevent movement inside the container.
3. Thoroughly seal shipping container and mark it "FRAGILE".
4. If shipping for service, attach a tag to indicate:
   a. Model and Serial Numbers.
   b. Service required.
   c. Description of malfunction.
   d. Return address.
   e. Authorization to conduct repairs.

2.5 STORAGE INFORMATION

The RF Units may be stored for extended periods without incurring damage to internal circuitry. To protect the instrument during storage periods, it is recommended that a full unit of activated dessicant conforming to Military Specification MIL-D-3464 be inserted inside the top cover. The instrument should then be packaged according to instructions for Repacking For Shipment contained in paragraph 2.4 above. When storing for extended periods, the dessicant should be changed (or reactivated) on an annual basis. The following safe limits for storage apply.

Temperature	-67° to +167°F(-55 to +75°C)
Humidity	95%
Altitude	40,000' (12,192M)

SECTION 3

OPERATING INSTRUCTIONS

3.1 INTRODUCTION

This section provides a detailed discussion of the operating controls, indicators and connectors which are part of the RF Units. Since these units are used in conjunction with the Model 430A Sweep Oscillator, a review of the operating instructions of that instrument are also provided.

The RF Units are available in 2 basic series: the 430A/430AH and the 430AP. The only difference between the two series is the available output power. The 430A/430AH series standard high power units provide at least 10 mW leveled power across their full band up through 18 GHz, and 4 mW unleveled to 26.5 GHz. The 430AP series super power units provide at least 20 mW leveled power across all bands to 18 GHz.

The series of RF Units covering the 0.01 to 18 GHz frequency range are provided with external leveling capability. Internal leveling is also provided as an option and is designated as -1. Each RF Unit contains a frequency source, its regulated supply, and leveling circuits and is available with an optional precision step attenuator providing a 103 dB attenuation range.

3.2 PANEL DESCRIPTION

3.2.1 Front Panel

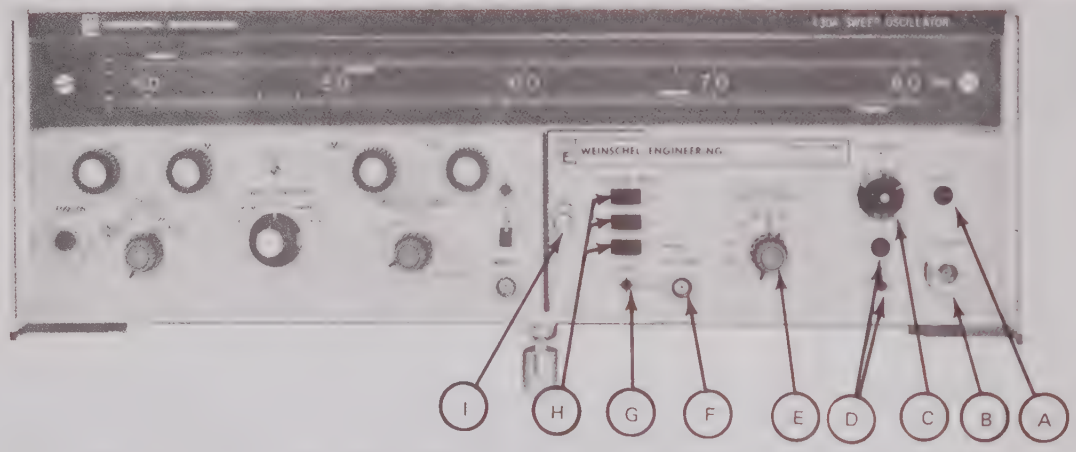
Figure 3-1 describes the function of all front panel controls, indicators and connectors for the RF Units. Additional information regarding the proper use of some of the controls is provided in paragraphs 3.3 through 3.5.

3.2.2 Rear Panel

The identification and function of connectors and controls located on the rear panel of the RF Units are shown in Figure 3-2.

3.3 OPERATION

Since the RF Units are an essential part of the Model 430A Sweep Oscillator, the information contained in the following paragraphs should be used in conjunction with the descriptions provided in Section 3 of the Model 430A Operating and Service Manual.



A UNLEVELED: Indicator lights when RF output is not leveled across the entire frequency range.

B RF OUTPUT: Connector provides RF output signal.

C RF LEVEL: Control sets amplitude of RF output; screwdriver adjustment standardizes control action for various external detectors.

D RF ON-OFF Switch and Indicator: Controls supply voltage to the RF source; indicator lights when RF Unit is operating.

E SYMMETRICAL SWEEP WIDTH: Select on of nine calibrated sweep widths; vernier provides continuous control over the entire band.

F EXT DET INPUT: Input connector for external leveling signal.

G GAIN: Adjustment controls Leveler gain in the Power Meter mode.

H LEVELER MODE Controls: Selects one of three basic modes of operation: OFF, INTernal or EXTernal (Internal leveling available only with -1 and -B options). Excluding Models 431A and 438A, LEVELER MODE controls not present on -2 option units.

I LOCK: Captive screw secures RF Unit in mainframe.

Figure 3-1. Front Panel Description

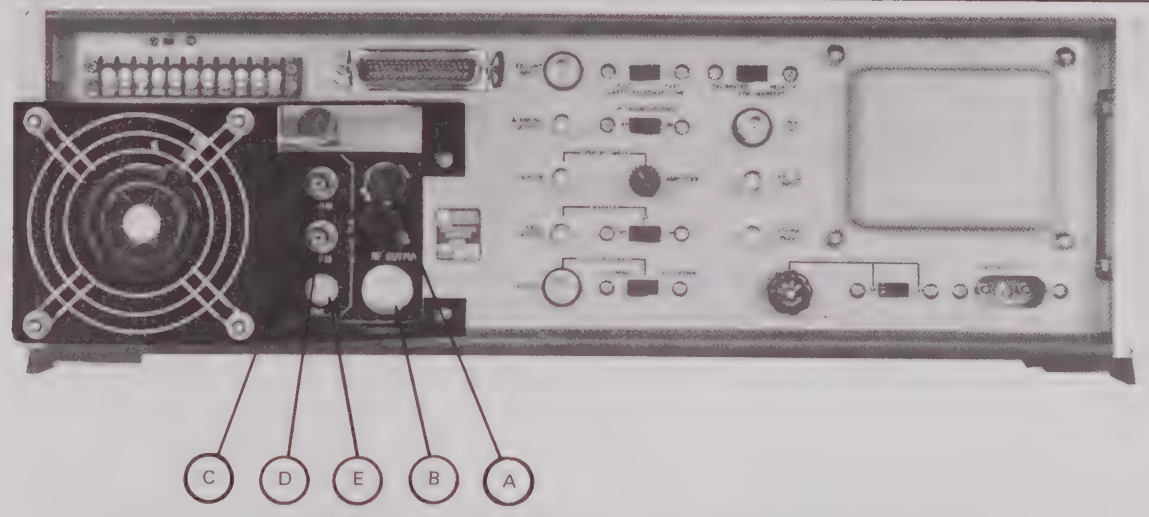
3.4 RF LEVEL

The continuously variable RF LEVEL control is used to select the amplitude of the RF output. Maximum RF output level is obtained by rotating the RF LEVEL fully clockwise. The screwdriver adjustment located in the center of the RF LEVEL control may be used as a coarse RF LEVEL control. The LEVELER MODE, OFF pushbutton should be depressed unless leveled power is to be used.

3.5 RF POWER LEVELING

3.5.1 General Considerations

The Model 430A with any RF Unit installed is capable of maintaining a constant amplitude RF output across the frequency range. This is accomplished by comparing the dc level from



A J1: Present on Models 431A & 438A-1 for external square wave and multiband signals.

B RF OUTPUT: Connector only present on RF Units with "R" option.

C AM INPUT: Connector for amplitude modulation signals.

D FM INPUT: Connector for frequency modulation signals and phase locking signals.

E PULSE INPUT: Connector for pulse modulation input signals which provide a rise and fall time of <50 ns. (Only available with the -03 option.)

Figure 3-2. Rear Panel Description

an RF amplitude sampling device with the amplitude command of the RF LEVEL control. The difference (or error) is amplified and applied to a voltage controlled attenuator which reduces the amplitude of the RF output to the desired level.

The RF LEVEL control may be adjusted to obtain a leveled output across the entire frequency range, or if required, may be set to obtain a leveled output only over that portion of the range where the amplitude of the RF power is higher. Since minimum power output usually occurs at one end of the frequency range, the RF LEVEL control should be adjusted for leveled operation at that end of the range to obtain leveled operation across the entire frequency range.

NOTE

The RF UNLEVELED indicator is functional only when the system is being operated between the maximum RF power level and the lowest allowable leveled power setting; typically 15 to 18 dB below the maximum leveled value. Operation below the specified dynamic range of the leveling loop will cause the UNLEVELED indicator to be temporarily inoperative and should be avoided.

The RF LEVEL control sets the maximum amplitude of RF power across the frequency range. Consequently, the RF output will be leveled in those portions of the frequency band where there is sufficient RF power but will remain unleveled in any portion where the amplitude of the RF power falls below the level established by the RF LEVEL control. The UNLEVELED indicator will only be illuminated during those portions of the sweep that are not leveled.

3.5.2 Internal Leveling

No external equipment is required to provide leveled RF power when using an RF Unit featuring internal leveling circuitry. These units have an internal directional detector consisting of a flat broadband directional coupler with a crystal detector. To activate the internal leveling function, simply depress the front panel LEVELER MODE, INT pushbutton and adjust the RF LEVEL control.

3.5.3 External Crystal Leveling

The output from any RF Unit may be leveled (except for those units with the -2 option) by using a remote RF amplitude sampler. This is especially desirable at the higher microwave frequencies to assure flat power at the input to the device under test. External leveling is also used to remove any power variations which may otherwise be introduced by a device inserted in the RF path such as a filter, an amplifier or a long transmission line.

For sweeping at high speeds to obtain a flicker-free oscilloscope display, depress the LEVELER MODE, EXT pushbutton. In this mode the leveling system may be used with a directional coupler (typically 10 dB) and a flat broadband crystal detector. A directional detector consisting of a coupler/crystal detector combination in a single package may also be used.

For optimum results over a frequency range of less than 2:1, a low pass filter with cutoff frequency at the high end of the desired band may be inserted before the directional coupler. The influence which any small harmonic content of the RF signal might have on leveling is thus prevented.

3.5.4 Power Meter Leveling

The ultimate in leveling accuracy and flatness across a broad band is obtained by substituting a RF power meter for the crystal detector. The long response time, however, of power meter thermistor mounts restricts Sweep Time selection to the two slower ranges, 1 SEC and 10 SEC, of the SWEEP TIME (SEC) Control. These two ranges are also suitable for use in conjunction with an X-Y recorder or with oscilloscopes other than the long persistence display types.

The power meter should have a minimum output of 1 volt or 1 millampere, either polarity. Typically, a 10 dB directional coupler and a low pass filter are used in the same manner described in Paragraph 3.9.3 of the Model 430A Operation and Service Manual. A leveled output power indication is calculated by adding the directional coupler coupling factor in dB to the power meter indication. The output power indication is influenced by both the front panel RF LEVEL control setting, and on the range selected for the power meter. It might be necessary to readjust the GAIN control when changing settings of the power meter range switch. The GAIN control on the front panel is only operative in the power meter mode of leveling.

When square wave modulation is used the leveling action of the power meter maintains constant (average) power. Since the duty factor of the internal square wave is 50%, the peak RF power will be twice the value indicated by the average reading on the power meter.

To minimize transients at the start of the sweep, it is recommended that the RF DURING RETRACE switch (located on the rear panel) be placed to ON.

SECTION 4
PRINCIPLES OF OPERATION

4.1 INTRODUCTION

This section contains a block level description of the 430A sweep system along with a detailed description of individual circuits. Complete schematic diagrams are provided in Section 7.

4.2 BLOCK DIAGRAM DESCRIPTION OF STANDARD SYSTEM

The Model 430A Mainframe, as shown in Figure 4-1, contains sweep generating circuitry consisting of a sweep trigger, sawtooth oscillator, sweep limiter and sweep amplifiers; a frequency marker generator; a square wave generator (for internal amplitude modulation); and a power supply section for generating the various voltages required for both the mainframe and the RF unit.

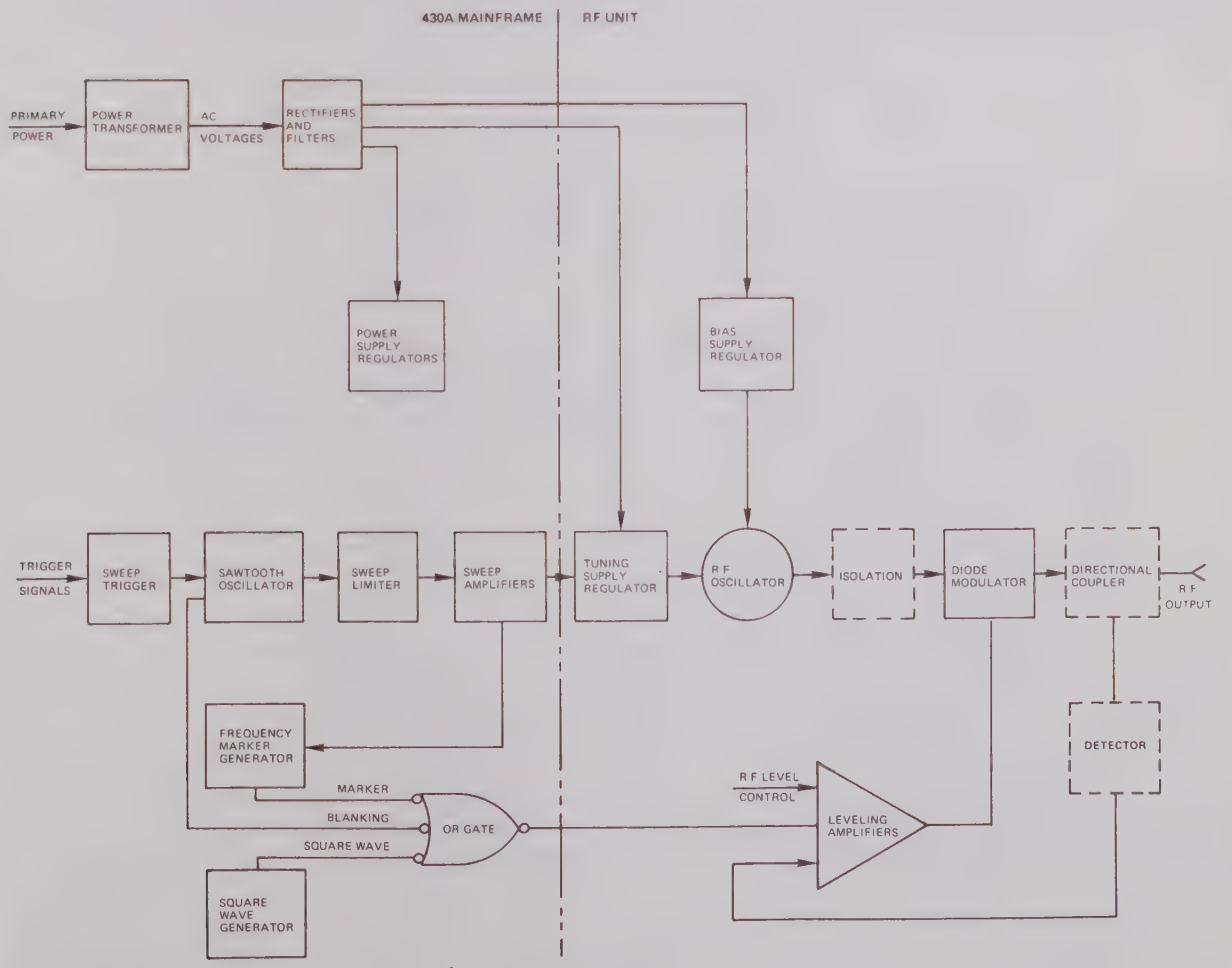


Figure 4-1. Block Diagram of Model 430A Mainframe and RF Unit

The function of the sweep trigger circuit is to reshape and standardize the negative going input trigger signal. The resultant positive output pulse is used to trigger the sawtooth generator which in turn develops a negative sawtooth voltage. This 0 to −12 volt waveform after being inverted and limited to +10 volts by the sweep limiter is applied to the sweep amplifiers which modify the positive point waveform in accordance with the front panel SWEEP FUNCTION control setting. The modified output from the sweep amplifiers is used to drive the tuning supply regulator which in turn controls the RF oscillator. As a result, the oscillator sweeps only that portion of its frequency range which corresponds to the sweep amplifiers' output waveform.

The amplitude of the RF output signal is determined by the electronically controlled attenuation of the diode modulator located in the RF Unit. The leveling amplifiers section drives the modulator with a control current determined by the setting of the RF LEVEL control. When leveling is in operation, a portion of the RF output is sampled by the directional coupler, detected and fed back to the leveling amplifiers as a negative feedback control signal. As the output frequency is varied the leveling control loop maintains the detector output at a constant level. The amplitude variation of the RF output therefore depends only on the characteristics of the directional coupler/detector combination for a given RF level setting.

The frequency marker generator circuit compares a sweep voltage with the marker control voltage to develop marker signals at the corresponding RF frequencies. The square wave generator, the retrace blanking signal and the markers, when individually activated by front or rear panel controls are gated through the OR gate and applied to the leveling amplifiers as modulation.

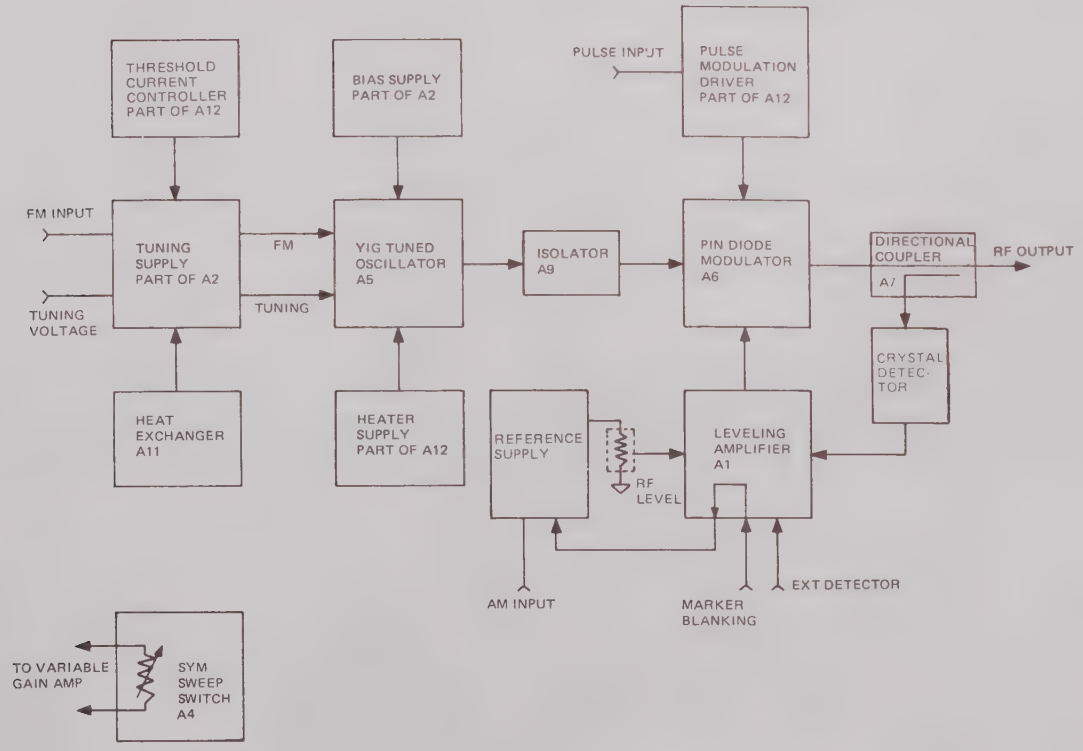


Figure 4-2A. Block Diagram YIG Tuned RF Unit (All Models Except 438A and 435A/4309A)

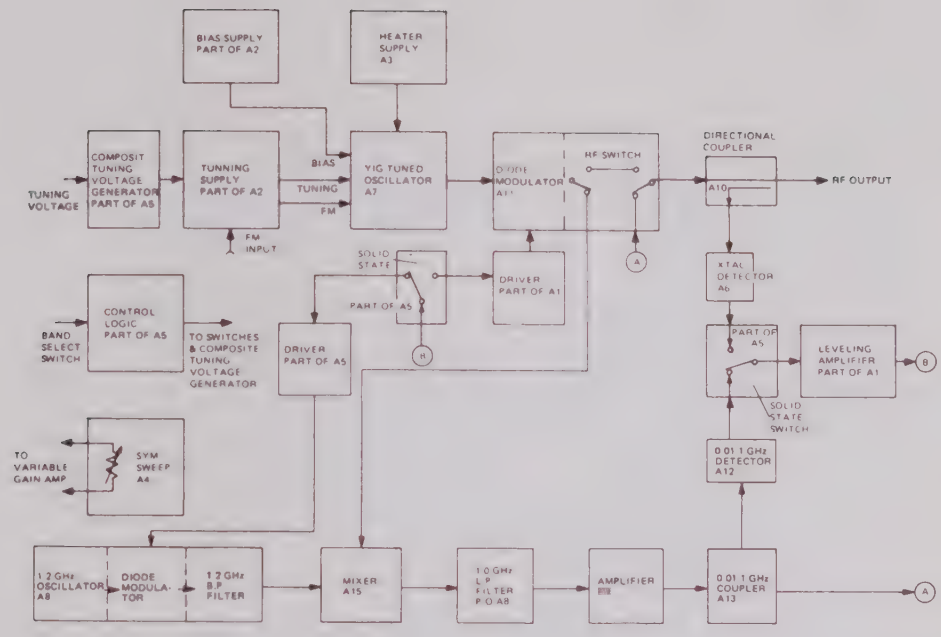


Figure 4-2B. YIG Tuned RF Unit (Model 438A Only)

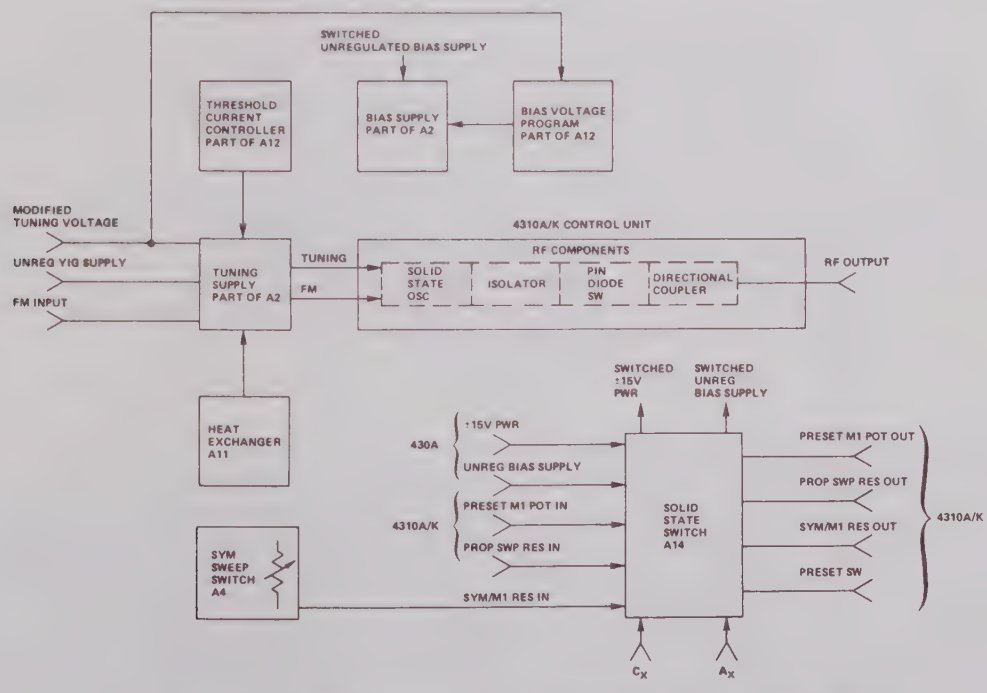


Figure 4-2C. Model 435A/4309A Interface Unit. Block Diagram (Serial No. below 1994)

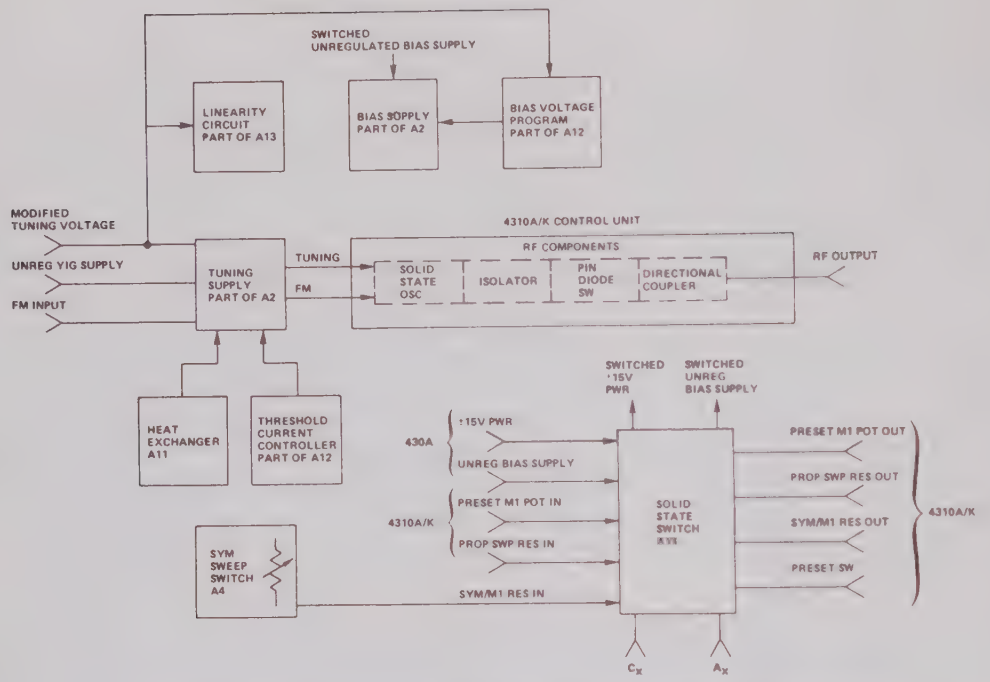


Figure 4-2D. Model 435A/4309A Interface Unit Block Diagram (Serial No. 1994 and up)

4.3 CIRCUIT DESCRIPTIONS

The following sections describe the circuits and controls located on assemblies:

A1	Leveler
A2	YIG Tunning & Bias Supply
A3	Auxiliary Termination Board (except 438A)
A4	Symmetrical Sweep Switch
A5	Control Logic (438A only)
A11	Heat Exchanger ("X" and "Ku" Bands only)
A12	Auxiliary Board
A13	Linearity

4.3.1 Tunning Supply, YIG (A2)

The feedback amplifier used to control the current in the tuning coils of the YIG tuned oscillator is shown in Figure 4-3. The circuit is configured as a current regulator. The voltage across the R sense resistor is determined by the ratio of R105 to R29 and the amplitude of the input tuning voltage. The current that flows through the YIG tuning coil is then determined by V_o and the parallel combination of R sense and R105. R sense is made to be considerably smaller than R105 and it dominates in setting the value of tuning coil current. The tuning coil current therefore is directly proportional to the input tuning voltage.

Under certain circumstances, the effective value of the input tuning voltage can drive the YIG tuning coil current beyond its normal operating range, and cause the RF oscillator to switch to a different mode of oscillation. This would result in an erroneous RF output from the sweeper. To prevent this from happening, a high frequency clamp (Amp 3) circuit is used. The values of R83 and R86 are selected so that when V_o exceeds a specified level, a signal appears at the output of Amp 3.

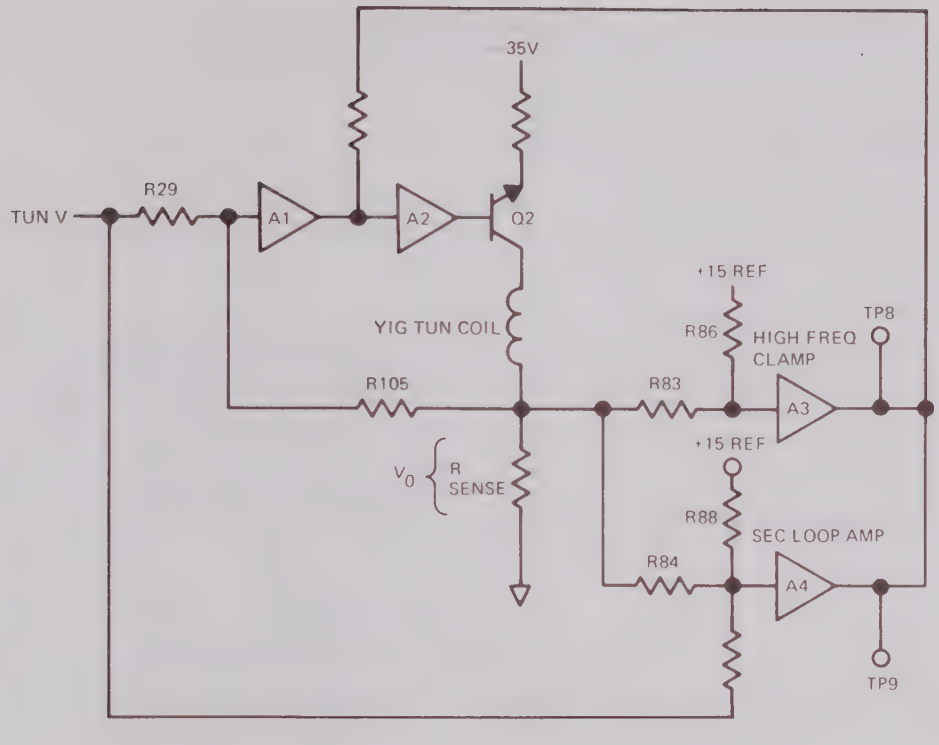


Figure 4-3. YIG Tuning Supply, Simplified Schematic Diagram

At all other values of V_O the output from Amp 3 is zero. In this way, when the YIG tuning coil current limit is exceeded, the main feedback loop is rendered ineffective by the feedback loop consisting of Amp 2, Q2 and Amp 3. This clamping feedback loop uses as its reference, the +15 volt supply via R86 and its action is to maintain V_O constant, independent of the increased level of the input tuning voltage.

4.3.1.1 Dual Feedback Loop (P/O A2)

When exceedingly fast waveforms are presented at the input of the YIG tuning supply, this high gain, but relatively narrowband, feedback amplifier circuit will experience non-linearities caused by slew rate limitation in one or more of its stages. The resulting distortion in the output and the subsequent recovery time delay would present frequency shifts and calibration inaccuracies beyond the limit of the specification. This problem is particularly severe in multiband operation.

To eliminate this type of distortion, a secondary loop amplifier (Amp 4) is used which functions in a manner not too dissimilar from the amplifier used in the high frequency clamp. It should first be pointed out that the slew rate limiting exists only in Amp 1. With this in mind, the input to Amp 4 is the difference between the input tuning voltage and the output V_O. When these two signals are in perfect synchronism, there is no output from Amp 4. When there is distortion, the output V_O does not follow the input and a net signal appears at the input to Amp 4. The output of Amp 4 is fed to Amp 2 in the same way as the high frequency clamp circuit and thereby removes Amp 1 from the feedback loop. The new loop consisting of Amp 4, Amp 2 and Q2 takes control and causes the output V_O to once again follow the input tuning voltage waveform. This secondary loop has a wider bandwidth (faster response) and responds with no slew rate distortion. It does, however, have a lower loop gain and would not be desirable for use when long term stability (drift) is important. This is taken care of automatically since the secondary loop is only active during the transient interval

when the main loop cannot cope with the rapid change required of it. Once the fast waveform has passed, loop control is returned to the high gain, high stability main loop.

4.3.1.2 Sweep Delay Compensation (P/O A2)

The frequency of a YIG tuned oscillator is tuned by changing the magnetic field in which the YIG material is located. The magnetic field is generated by an electromagnet driven by a current source.

Let us assume a perfect current driver, that is, one which will produce a current sawtooth in perfect synchronism with the sawtooth tuning voltage. We would expect the output RF frequency to be in perfect synchronism also. In fact, however, this is only true at slow sweep rates and is not realized at high sweep rates because of eddy (induced) currents in the magnetic material of the electromagnet. We find that as the sweep speed is changed, the linear relationship between RF frequency and tuning coil current is distorted, and produces a frequency shift as seen on the displayed response. The effect is, therefore, most noticeable at high sweep speeds and is a particular problem in multiband systems where an entire octave must be swept in only a fraction of the time available for the full sweep.

Since this sweep delay distortion is not inside the closed loop of the YIG tuning supply, a compensation signal must be introduced and combined with the tuning voltage signal. The combination of these two signals comprise a distorted input which is time sensitive and non-linear in exactly suitable proportions that will result in a linear, and sweep time independent, relationship between the output frequency and the linear sawtooth sweep voltage.

The circuit used to provide the compensation signal is shown schematically in Figure 4-4. The essential characteristic of the compensation signal can be seen in the waveform at TP6. There is

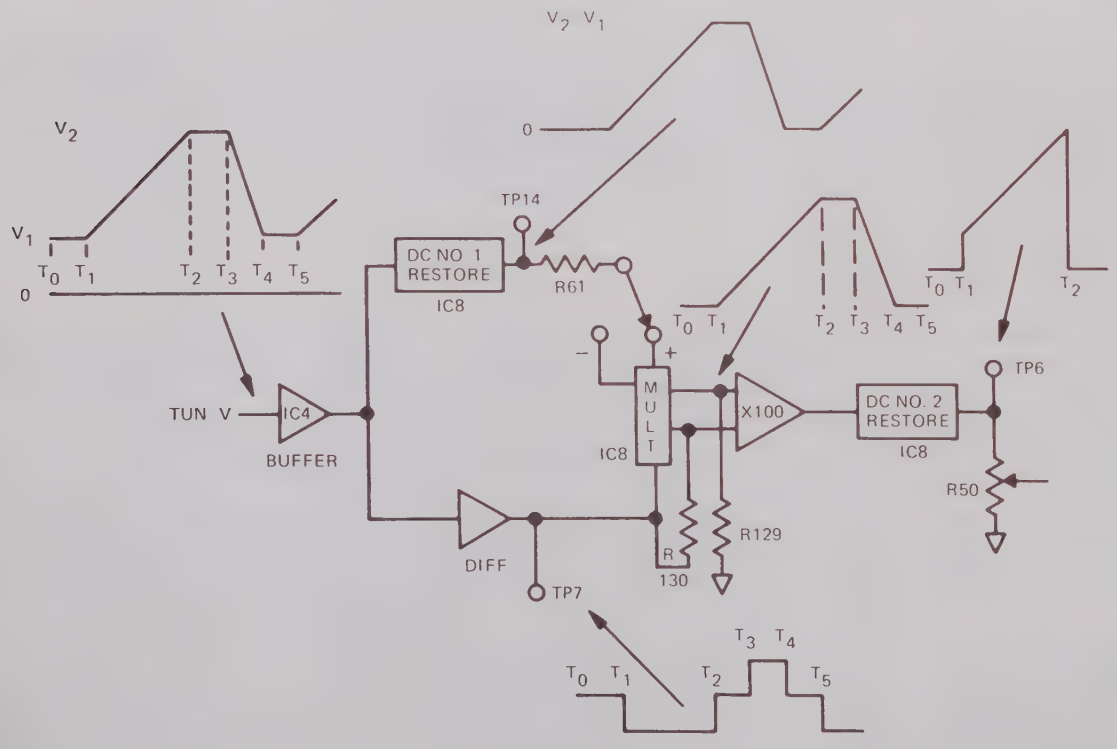


Figure 4-4. Sweep Delay Compensation, Simplified Schematic Diagram

a step component summed with a ramp component. The step is formed by differentiation of the input sawtooth and feeding the resulting step to TP6 via IC4. The ramp component is generated by multiplying the dc restored tuning voltage sawtooth with the output of the differentiator. This signal is combined with the step in IC4 and the combined signals appear at TP6. As the sweep rate is varied, the value of the derivative changes. This results in an increase in step height and an increase in ramp slope with increase in sweep speed.

To adjust the circuit for exact compensation, R61 is selected to provide the correct ramp slope and R130 and R129 are selected to provide the correct step amplitude. R130 must always be equal to R129.

DC restorer circuits are used so that the sawtooth compensation signal can be set to 0 volts at the beginning of sweep independently of the dc level present in the input tuning voltage signal. The DC level at the input is a function of the setting of the F1 control. Typically, it is at some frequency other than the low end of the band.

The compensation signal is combined with the tuning voltage signal at the input stage of the YIG tuning supply, Q8.

4.3.1.3 Automatic Tuning Supply Bandwidth (P/O A2)

In normal operation in the swept mode, and at maximum sweep speed, the full bandwidth of the tuning supply is required so that there is no undesired distortion of the linear sawtooth drive signal to the RF oscillator. At slower sweep speeds and in the CW mode the bandwidth requirement is reduced because of the slow tuning waveform. If the bandwidth is reduced the amplitude of the noise on the tuning signal will be reduced in proportion to square root of the bandwidth, and thereby reduce the residual of FM on the RF output frequency.

In the 430A Series of RF Units, the tuning supply bandwidth is automatically controlled in accordance with the sweeping rate used by the operator. A simplified diagram of this circuit is shown in Figure 4-5. The bandwidth is determined by R105 and the capacitance C29 or the parallel

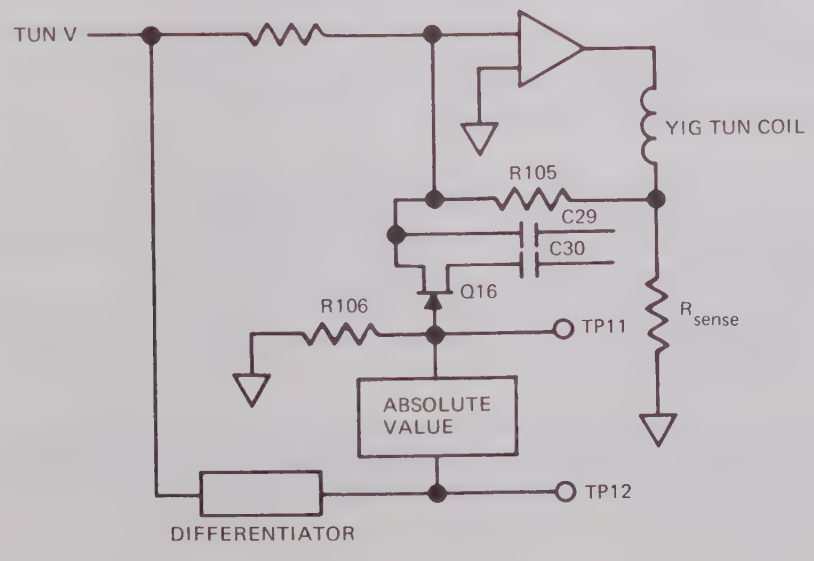


Figure 4-5. Automatic Tuning Supply Bandwidth, Simplified Schematic Diagram

combination of C29 and C30. The maximum bandwidth occurs when Q16 is an open circuit and the minimum bandwidth occurs when Q16 is a short circuit.

The state of Q16 is controlled by the absolute value generator circuit which in turn is supplied with the derivative of the tuning voltage. It can be seen, therefore, that at sufficiently high sweep rates, the derivative will be large enough in amplitude to cause Q16 to open circuit and thereby increase the bandwidth of the tuning supply.

The differentiator is shown in Figure 4-6 where C27 and R97 determine the differentiating time constant. The zener CR35 is combined with the diode bridge circuit in the feedback path to limit the maximum positive or negative amplitude at the output of the differentiation.

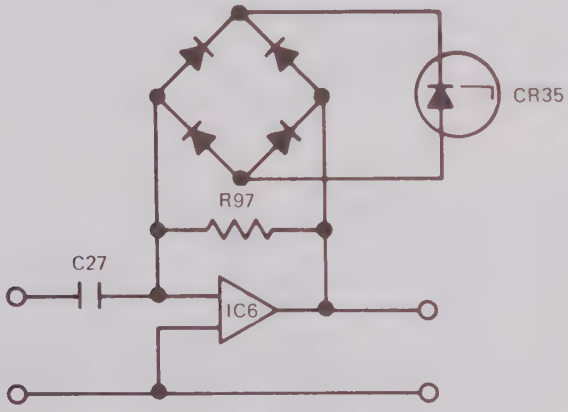


Figure 4-6. Differentiator, Simplified Schematic Diagram.

The absolute value generator is shown in Figure 4-7. Amplifier A1 is an operational summing amplifier providing the sum of two signals:

1. The input V_1.
2. The output V_2 from amplifier A2.

The values of circuit resistance are such that if V_1 is negative the gain of A1 via R94 is twice the gain via R93 and the resulting output is equal to $-V_1$. When V_1 is positive, amplifier A2 is eliminated by virtue of the diodes in its feedback path which reduce its output to 0 volts when the input is positive. Hence, only A1 is operative and the output is again equal to $-V_1$.

4.3.1.4 Varactor Tuning Supply (P/O A2)

The voltage vs. frequency curve for the varactor tuned oscillator is non-linear and it requires a "distorted" sawtooth drive in order to compensate and thereby provide a linear overall voltage vs. frequency relationship. The "distortion" or shaping is done in the same operational amplifier used as the tuning supply.

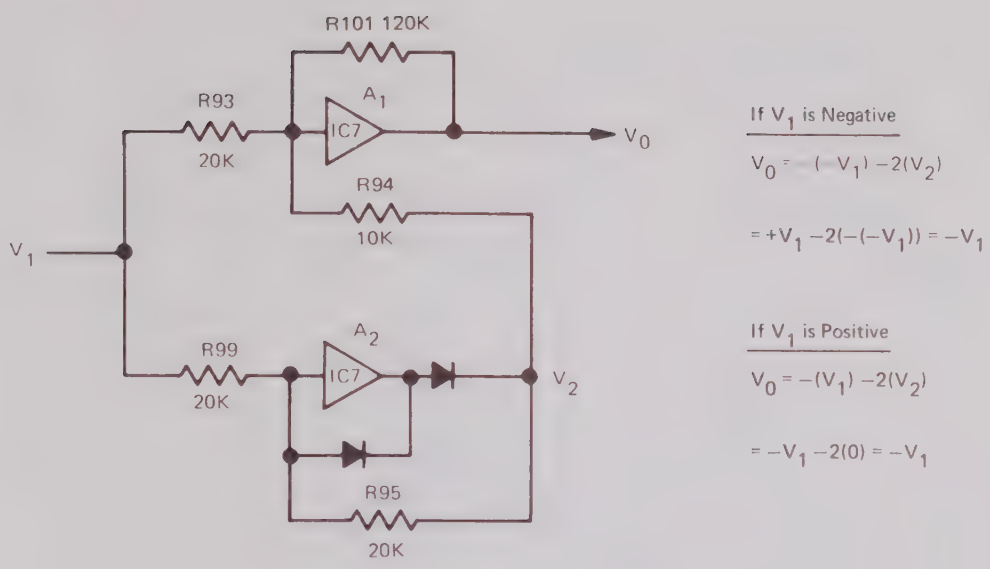


Figure 4-7. Absolute Value Generator, Simplified Schematic Diagram

A simplified nonlinear amplifier is shown in Figure 4-8. A linear sawtooth signal, V_1, at the input results in a linear current I_1 which also flows through R2. With the increase in instantaneous value of I_1 the potential at the junction of R2 and R3 increases until CR1 is forward biased and conducts current I_4. The resulting output current $I_3 = I_1 + I_4$ and output voltage $V_0 = -(I_1R2 + I_1R3 + I_4R3)$ as illustrated in Figure 4-8B are non-linear.

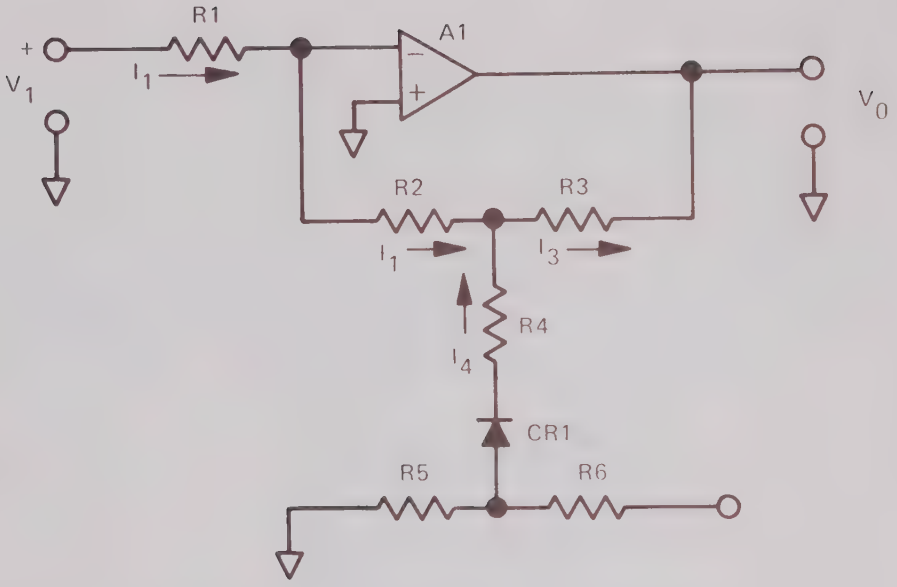
This technique is expanded with the use of many diodes and can provide an essentially smooth curvature in the nonlinear shaping.

A more detailed schematic of the tuning supply is shown in Figure 4-9. Here the shaping network is augmented with transistor Q10 which is used to introduce a segment of reverse curvature by reducing the effective output voltage when a sufficiently negative potential exists at the junction of R45 and R38. At that time Q10 conducts and shunts R45 with resistor R26. Since the output voltage is a function of the voltage drop across R45, the action of Q10 causes a reduction in the rate of increase in output voltage.

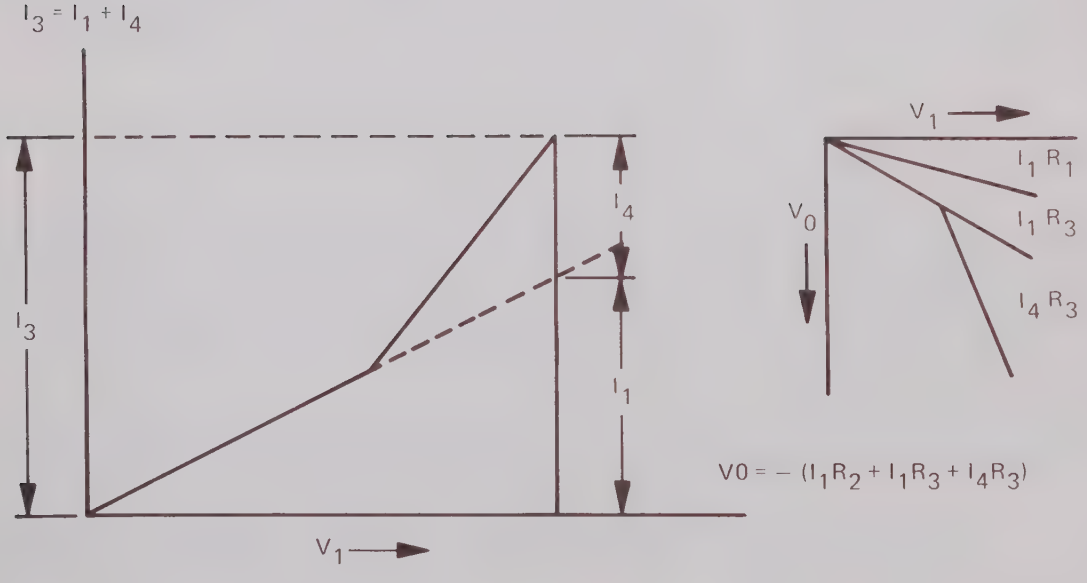
This reverse curvature is used to correct for corresponding reversals of curvature in the varactor oscillator's tuning characteristic.

A high voltage preregulator is used and consists of a constant current generator, Q6 and CR38, driving zener CR39. Transistor Q9 is used as an emitter-follower to supply the high current requirements of the output stage.

In the actual circuit, additional transistor stages Q4, Q13 and Q19 are used to provide current and voltage limiting where signal transients would otherwise cause undesirable nonlinear distortions.



—A—



—B—

Figure 4-8. Simplified Nonlinear Amplifier

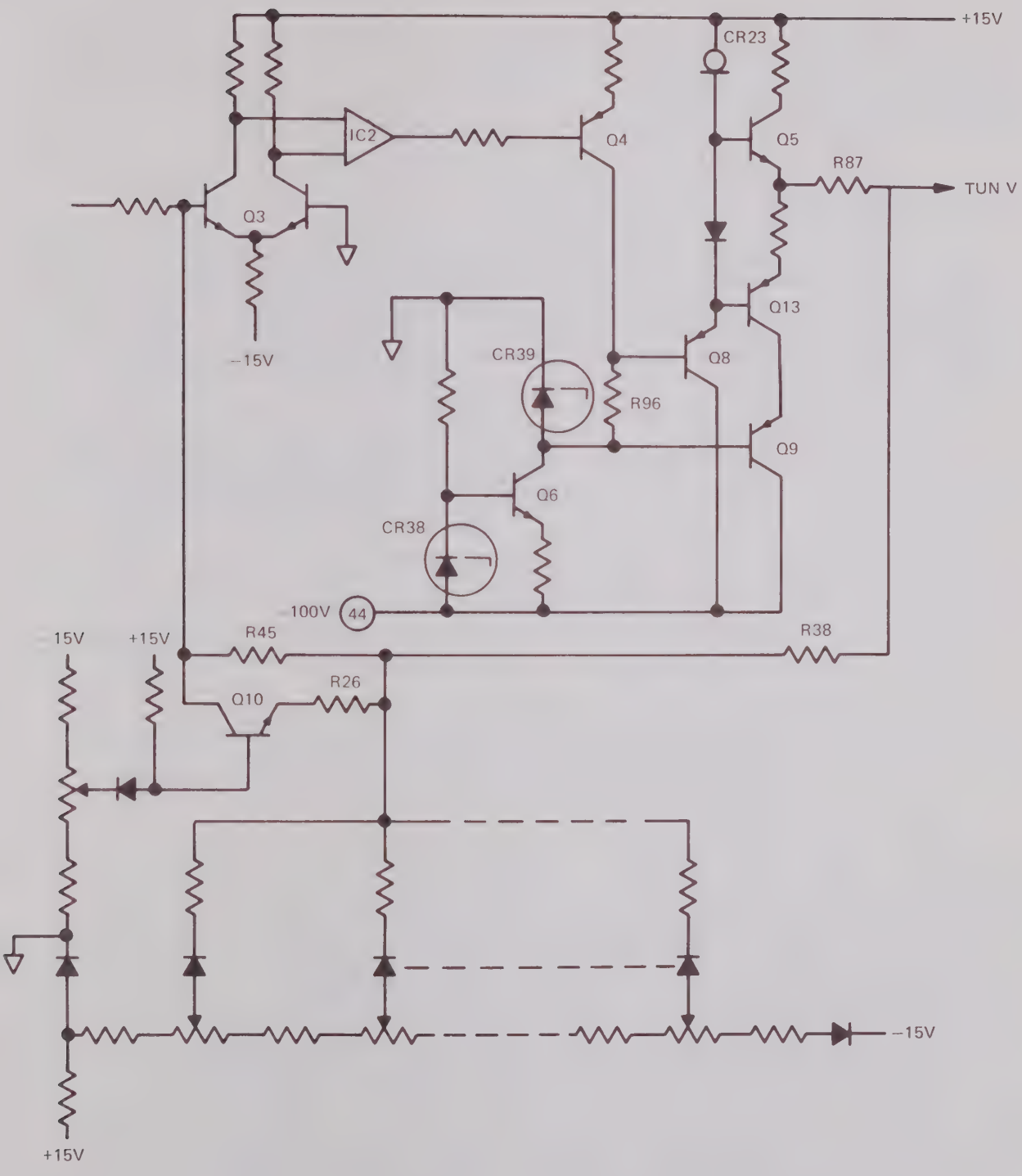


Figure 4-9. Tuning Supply.

4.3.2 Leveling Circuit (A1)

The leveling circuit controls the amplitude of the RF output. In the leveled mode, the amplitude is maintained constant as the RF frequency is swept across the band. In the unleveled mode, the normal variation in RF source amplitude will be present at the output.

In the leveled mode, a feedback amplifier is used consisting of a high gain amplifier, RF diode modulator, directional coupler and RF detector. This circuit is shown as a simplified block diagram in Figure 4-10.

The forward path consists of all the elements described above and the feedback path is amplifier A1. It can be seen, therefore, that the function of the leveling amplifier is to maintain the voltage at the output of amplifier A1 constant and proportional to the reference RF level control setting. Since the transfer characteristic of amplifier A1 is constant and independent of RF frequency and RF amplitude, the output of the crystal detector is kept constant and proportional to the reference RF level control setting.

If the transfer characteristics of the directional coupler and crystal detector are independent of RF frequency over the band of interest, then the loop will adjust the attenuation of the diode modulator so that the amplitude of RF output will be constant as the RF frequency is swept across the band.

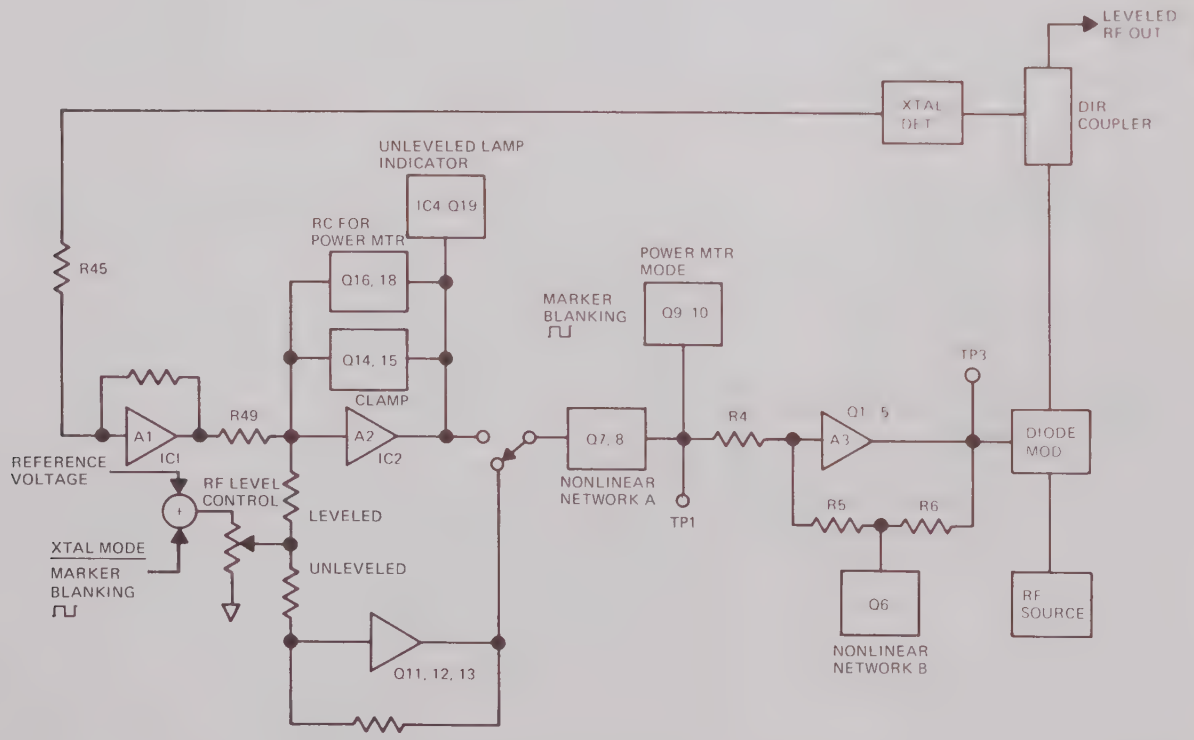


Figure 4-10. RF Leveler Simplified Block Diagram

4.3.2.1 Linearized Loop Gain (P/O A1)

The operation of leveler described so far assumes that the loop is stable and that there are not excessive variations in forward loop gain. In normal use, however, the change in RF level control settings causes the RF output level to change over a sufficient dynamic range (in excess of 10 dB) that the square law characteristic of the XTAL detector, and the nonlinear transfer characteristic of the diode modulator cause excessive variation in forward loop gain. This gain variation gives rise to the following dilemma.

If the closed loop bandwidth is high enough at the high gain conditions in the loop to provide the desired rise time for the leveler, the closed loop rise time will be inadequate when the loop operates at the low gain conditions. On the other hand if the loop gain is increased so that adequate closed loop bandwidth is obtained at the lower gain conditions, then when the loop operates at the high gain conditions there will be excessive phase shift in the loop resulting in overshoots, ringing or even loop oscillation. In the past, sweeper manufacturers provided a front panel "loop gain" control and required the operator to optimize the loop gain for the particular operating RF level. In the 430A leveler, a combination of non-linear networks are included to cancel the non-linearities of the diode modulator and XTAL detector, and thereby provide uniform rise time for all RF level settings without overshoots or ringing on the output RF waveform.

The A2 amplifier contributes the most gain to the loop and as a result requires special care when the leveler is required to turn RF power on or off under the control of fast waveforms such as pulse modulation, blanking, etc. When the control signal directs the RF to be turned off, there is no signal returned from the XTAL detector and the feedback loop is effectively opened. With this loss in control, the A2 amplifier will saturate and the capacitors used for phase shift stabilization will charge to the supply voltage. If, at this time, the control signal directs the RF to be turned on to a specified level, the loop will remain open until the charged capacitors discharge to the normal operating levels. This will cause a delay in the output RF turn-on waveform and also generate a recovery transient that will distort the output.

To overcome this problem, a clamp circuit consisting of Q14 and Q15 is biased so that they conduct when the output of IC2 exceeds the limits of ± 4 volts. This controls the output swing of IC2 to a value that does not introduce any significant delay or transient distortion.

4.3.2.2 Power Meter Leveling (P/O A1)

When the RF detector used for leveling is a power meter using a thermistor transducer, the stabilization of the leveling loop must be modified. The thermistor element has a slow response time and thereby introduces excessive phase shift in the feedback loop resulting in loop oscillation. To avoid this, a stabilization network shown in Figure 4-11 consisting of C28 and R42 is introduced by switching Q18 on or off via Q16. With the modified loop stabilization, the response time of the closed loop is drastically reduced to the order of *seconds*. This response time is perfectly compatible with the power meter which is essentially dictating the entire loop response. The operator must, however, be sure to limit the SWEEP TIME (sec) selector to the region between 10 and 100 seconds because the RF frequency sensitive variation will not be removed at the higher sweep rates.

The level modulation by the RF markers, square wave, and blanking waveforms from the "on" circuit in the 430A mainframe is introduced after the slow responding amplifier via Q9 and Q10. The response time of the leveling loop is too slow to follow the 1 kHz square wave modulation and therefore the average power of the modulated waveform will be regulated. Since the duty factor is 50%, the peak power with square wave modulation will be twice the average power. RF DURING RETRACE should be left ON for best results when power meter leveling.

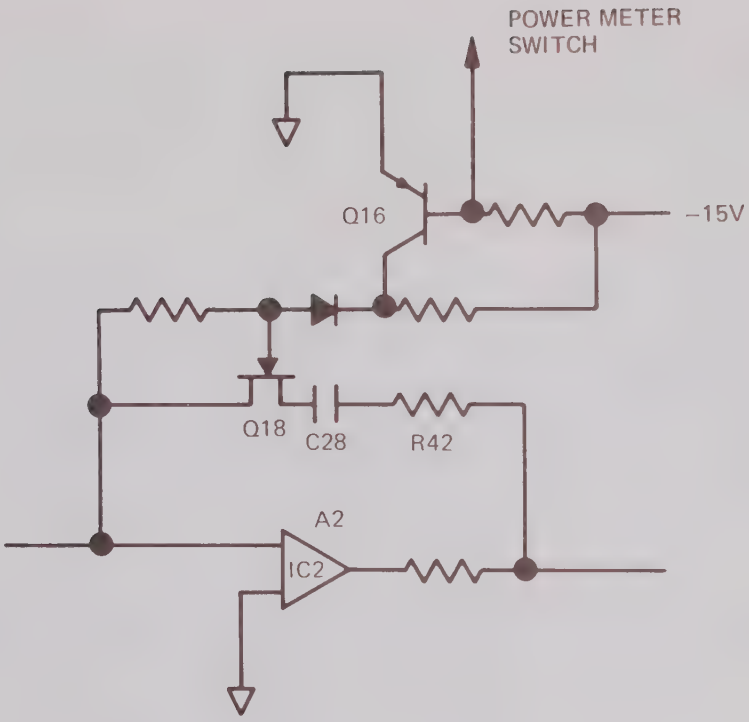


Figure 4-11. Power Meter Leveling Stabilization Network

4.3.2.2.1 Gain Control - Power Meter Leveling (P/O A1)

When the range setting on the power meter is changed, and for example assume it is reduced (lower power level), the leveling feedback loop operates to cause the needle on the power meter to remain stationary. The meter reading is equivalent to the signal output used to complete the feedback path and, therefore, the leveling loop must reduce the RF power into the power meter at the lower range setting. Under this circumstance consider the effective transfer gain of the power meter. Since its output is constant with a reduction in input power, the gain of the power meter is increased. It can be seen, therefore, that the leveling loop gain is a function of range setting of the power meter. It is necessary to provide a gain control for the operator to optimize the loop gain over the range of settings used on the power meter. This control is a front panel screwdriver adjustment R4 and *is operative only in the power meter leveled mode.*

4.3.2.3 Auto Polarity Circuit (P/O A1)

The leveling circuit normally operates with a specific polarity at the output of the RF detector. In some equipment a switch is provided to adjust the circuit configuration when this polarity is changed. In the 430A RF Units a circuit is included which automatically does the switching described above when the polarity of the detector is changed. This means that for either the "XTAL" or the "power meter" mode the leveling circuit will automatically adjust to either polarity used.

A simplified block diagram of the circuit that controls this operation is shown in Figure 4-12. The input to A1 is controlled by a DPDT relay which changes the polarity of its gain. The output of A1 is sensed by a comparator circuit which will produce a transition when the level at TP 4 exceeds a specified value and polarity. This level is exceeded (+0.15 volts) when the wrong polarity occurs at the input and the loop attempts to increase the RF output. The transition turns on both the multivibrator, which oscillates at a few cycles per second, and the gated flip-flop which is also driven by the multivibrator. The output of the flip-flop drives a binary relay driver.

One state of the multivibrator will set the relay contacts to a position which is correct and the output of A1 will go negative. This condition will remove the transition at the output of the comparator and the leveling loop will then operate normally.

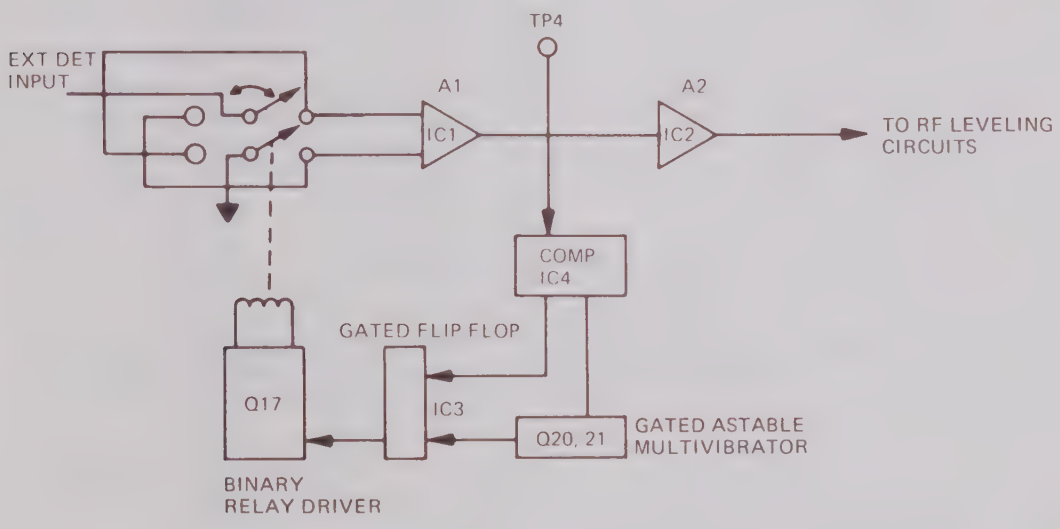


Figure 4-12. Auto Polarity Circuit, Block Diagram

4.3.2.4 Amplitude Modulation (P/O A1)

All control of the RF amplitude is done via the RF Diode Modulator and its control circuit, the Leveler. In addition, to any external AM input signals, the internally generated signals are combined in the leveling circuit to form one composite amplitude modulated waveform. These signals include: frequency markers, retrace blanking, square wave and corrective leveling signals.

In the leveled mode, all of these signals are combined linearly in the operational amplifier that defines the leveling loop. If the reference crystal detector used in leveling is operated in its linear range, the output RF Amplitude will be linearly modulated with the input AM signal. If the reference crystal detector is operated in its square law region, the output RF POWER will be linearly modulated also.

4.3.3 Bias Supply (P/O A2)

The Bias Supply furnishes the power to the Gunn Diode or Transistor in the RF oscillator, as may be the case in a particular RF Unit. A simplified schematic diagram is shown in Figure 4-13. The supply shown here is a "POSITIVE OUTPUT" configuration used in those RF Units which require a positive voltage with respect to ground for its bias supply.

In some RF Units, a heater supply is also required where the heater voltage is higher than the bias voltage. This dual supply is obtained from terminals W and V. The regulator operates to control the potential at terminal V and the zener CR47 provides a sufficiently accurate and stable voltage increase above the bias voltage to meet the requirements of the heater.

The regulator is a typical operational amplifier configuration with R8 being the feedback resistor and the series combination of R9 and R19 being the input resistor. The amplifier gain is the cascade combination of IC1 and Q1 (located on the RF Unit mainframe).

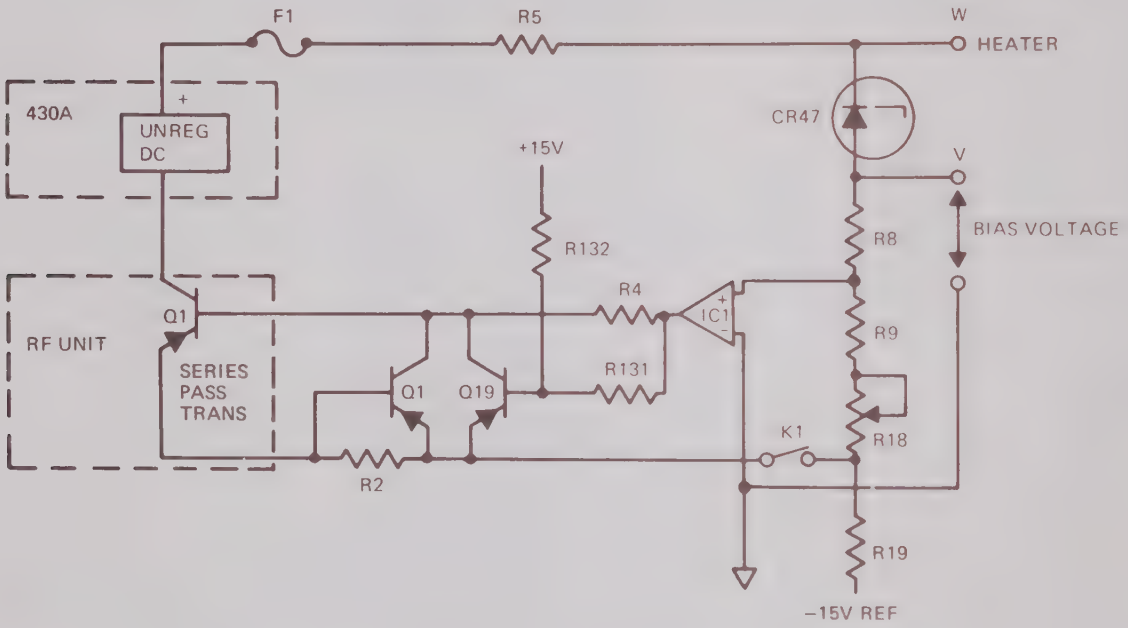


Figure 4-13. Bias Supply, Simplified Schematic Diagram

4.3.3.1 Protective Circuits (P/O A2)

To prevent damage to the RF oscillator source, a number of protective circuits have been included in the design of the bias supply. These circuits, in many cases, are redundant, however, the higner replacement cost of the RF oscillator more than justifies this precaution.

4.3.3.2 Inhibiting Delay (P/O A2)

When the ac power is first applied, as during a normal equipment turn on, the sequence of turn on for the + and −15 volt supplies is uncontrolled. As a result, the output of the bias supply could overshoot the desired value during the time interval between power on and stabilization of the + and −15 volt supplies.

To prevent overshoot, Q19 is wired in shunt with the drive to the output series regulator. In normal operation, the output of IC1 is negative and Q19 is biased off causing it to have no effect on the operation of the bias supply. Assume that the +15 volt supply is on before the −15 volt supply reaches its final value. Under this circumstance the output of IC1 will be positive and keep the output series regulator cutoff and the output of the bias supply will be zero. If we next assume that the −15

volt supply is on before the + 15 volt supply, Q19 will be biased "on" via R132 causing any drive current to the output series regulator to be shunted through Q19 and the output of the bias supply will be zero.

As the lagging supply voltage reaches its normal level, the bias supply will smoothly rise to its normal level with no overshoot.

4.3.3.3 Current Limiting (P/O A2)

The current limiting circuit consists of transistor Q1 and resistor R2. As the bias supply load current exceeds the desired load current, the voltage drop across R2 increases in a direction which causes transistor Q1 to conduct thereby shunting the drive current to the series pass transistor. This action causes the output bias supply voltage to drop to a level that will maintain the load current constant and equal to the level set by the selection of the value of R2.

In the actual circuit, a feedback network is applied to the current limit transistor Q1 via R1 and R3 to generate a foldback characteristic that will cause the load current to stabilize at a much lower value after the current limiting circuit has been actuated. This feature reduces the power dissipated in the series pass transistor if the output of the bias supply remains short circuited for an indefinite period of time.

4.3.3.4 Fuse

If circuit components of the current limiting circuit should fail, and an increase in load current occurs, fuse F1 is designed to blow and thereby protect the RF Source.

4.3.3.5 Crowbar Circuit (P/O A2)

The crowbar circuit is illustrated in Fig 4-14. Its purpose is to provide protection to the RF Source in the event that the bias supply voltage exceeds a safe level. In operation, the SCR CR7 is

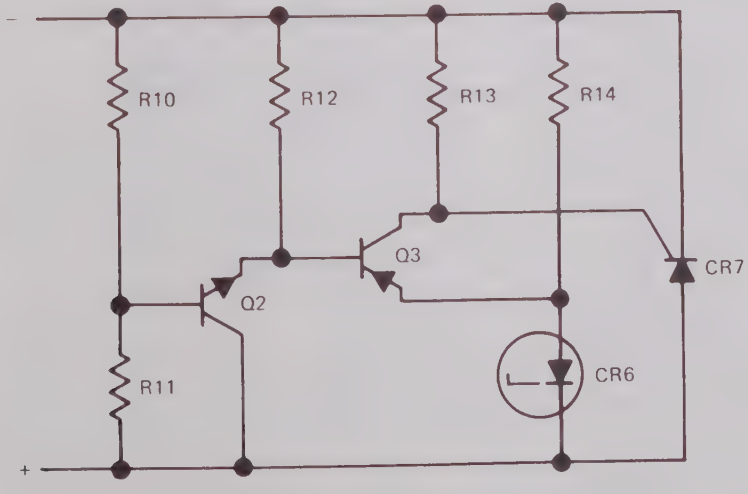


Figure 4-14. Crowbar Circuit

fired and produces a short circuit across the bias supply thereby reducing the bias voltage to zero. A reference voltage developed by Zener CR6 is compared with a sample of the output of the bias supply in transistor Q3. As the bias supply voltage increases, the base of Q3 becomes more negative until it is more negative than its emitter at which point, Q3 conducts and CR7 is fired. The critical level at the base of Q3 is set by the value of R10.

4.3.4 FM Input Circuitry

The method for providing a direct-coupled wideband FM input is shown in Figure 4-15. The input signal is frequency multiplexed via a high pass and low pass filter which, in turn, feed the modulation signal frequency components to the FM coil and the main tuning coil, respectively.

The FM coil is a special winding in the YIG tuning structure which has an air core and operates at high frequencies. The air core has lower "core loss" at higher frequencies and thereby provides wideband performance. The lower permeability of air compared to the iron core reduces the flux density for a given magnetizing current and for this reason the FM coil cannot cause large frequency deviations.

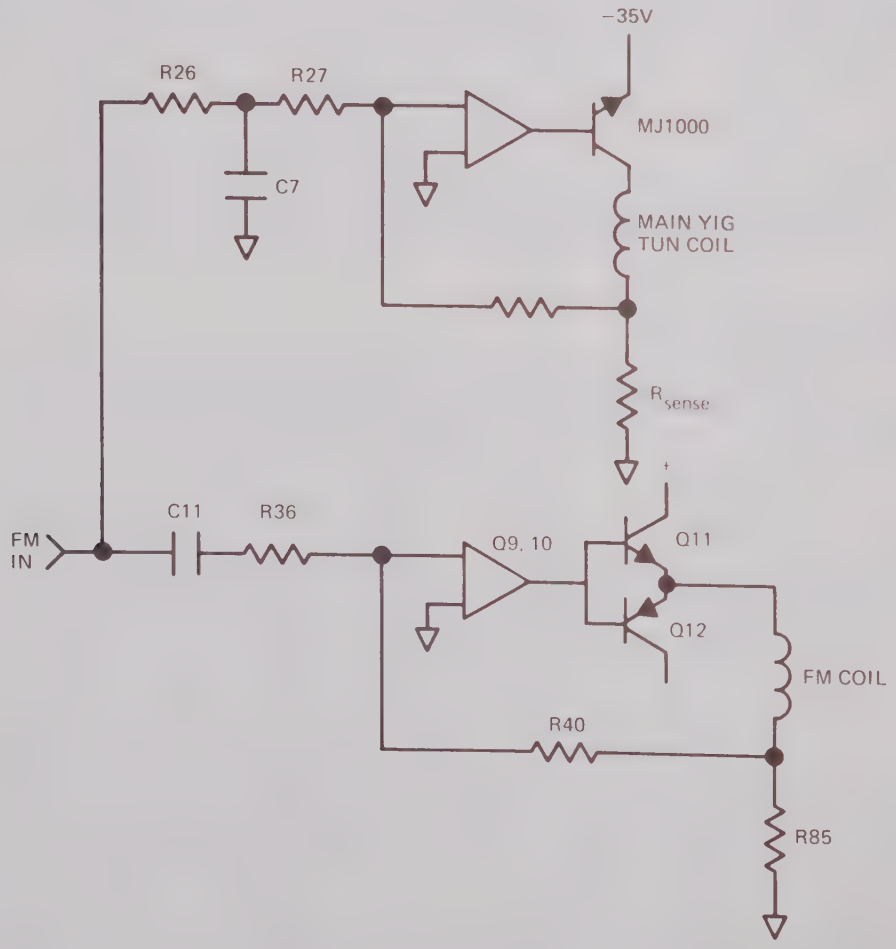


Figure 4-15. FM Input Circuitry

4.3.5 Heat Exchanger (A11)

In the higher frequency bands and for YIG tuned RF sources, the tuning current and consequently the power required for tuning this source is quite high (i.e., 30 - 50 watts). To avoid dissipating all of this power in one series pass transistor and cause intensive heat dissipation in one location, some of the tuning current is supplied by Q2 as shown in Figure 4-16.

Transistor Q2 is the heat exchange sink and is located as far away from the series pass transistor as is practical. In operation, the current required at the low end of the tuning range is supplied by Q2 and as current is required with increasing RF frequency, it is furnished via the series pass transistor.

The transistor Q1 is used to control the heat exchange circuit and shut it off when the RF Unit is in standby in multiband operation. The control signal is the presence or absence of the −15 volt supply to R1.

4.3.6 Remote Tuning

The remote tuning input signal is summed algebraically via R28 with all other tuning signals in an operational amplifier called the tuning supply. These inputs are always active and the user must,

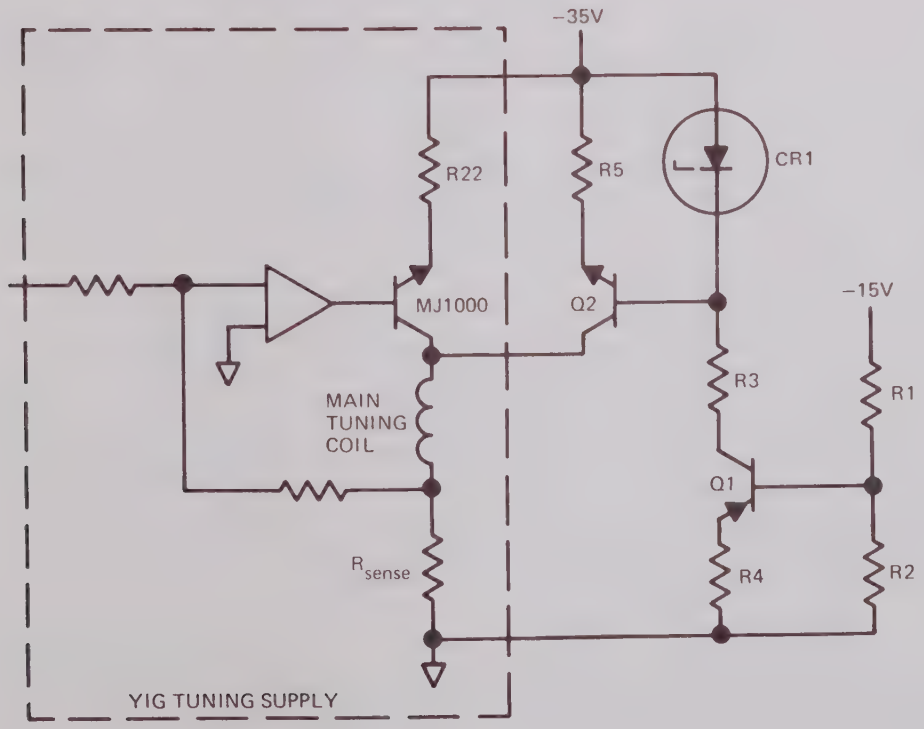


Figure 4-16. Heat Exchanger Circuit

therefore, be sure that the other controls are set in their appropriate positions to either combine with the remote signal or not interfere with the remote signal.

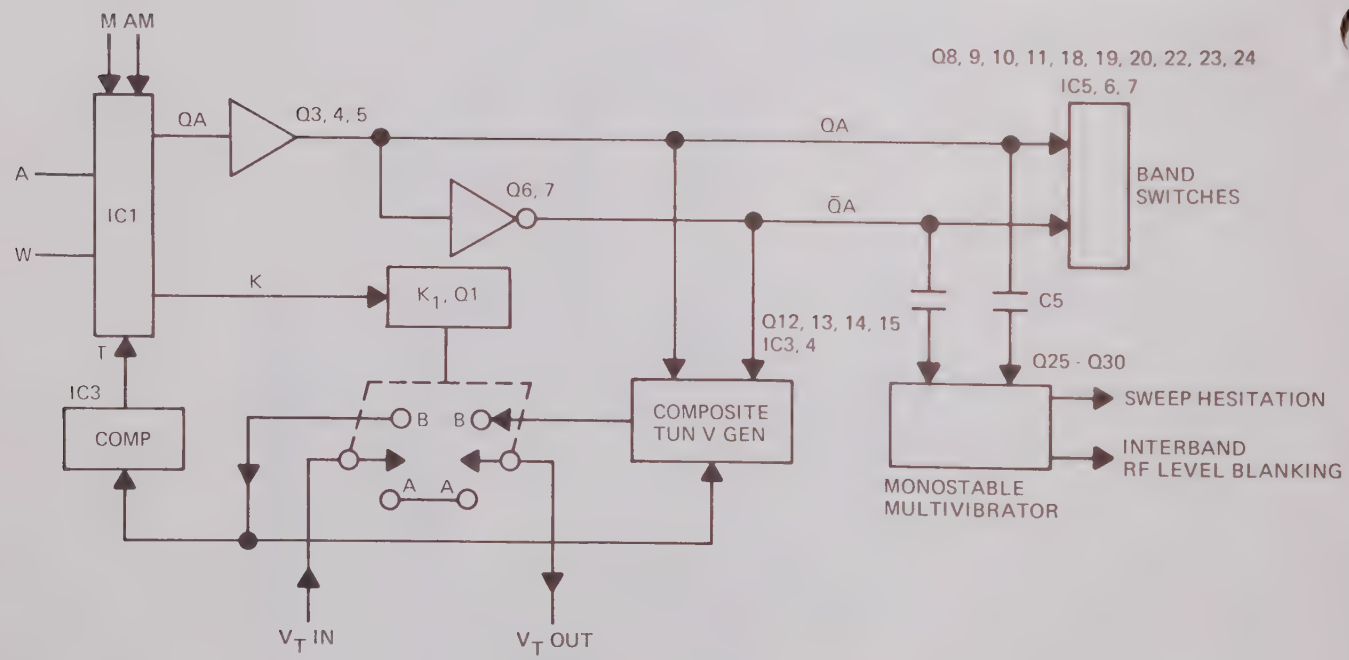
For exclusive control of the tuning supply by the remote tuning signal, the model 430A controls should be set as follows:

Control	Setting
SWEEP FUNCTION	EXT/M1
M1	Fully CCW

4.3.7 Remote ON/OFF

The remote on/off function is intended to reduce the RF output to absolute zero without adjusting any other controls or removal of ac line power. This is done by reducing the bias supply voltage to zero which will stop RF oscillations in the RF source.

A relay controlled switch, K1, is used to set the reference for the bias supply to zero, as shown in Figure 4-13.



V_T (IN) = TUNING VOLTAGE FROM 430A MAINFRAME
V_T (OUT) = TUNING VOLTAGE TO RF OSCILLATOR

Figure 4-17. Block Diagram of Control Logic

4.3.8 Heterodyne Unit Control Logic A5 (438A-1)

The dual range of the 438A RF Unit can be used either one at a time or in a multiplexed sweep where the 10 MHz - 1 GHz range is displayed continuously with the 1 - 2 GHz range providing a full 10 MHz - 2 GHz presentation in a single sweep. This multiplexed sweep is referred to as the WB (Wide Band) mode. A block diagram of the control logic for this system is shown in Figure 4-17.

IC1 provides the combinatorial logic shown in Figure 4-18.

The output signals QA and K are used to control all switching and gating circuits.

The combination of signals that result in K = 1 will set the DPDT switch K1 in position A-A and disconnect the input signals to the comparator and composite tuning generator circuits. The QA signal will position the band switches as described in paragraph 4.2.1 and the block diagram in Figure 4-2. In this manner the 10 - 1000 MHz or the 1 - 2 GHz range can be selected.

It should be noted that when the 438A is plugged into a 4310A/K multiband system (M = 0) range selection is made via a control signal A_m received from the 4310A/K.

When the Wide Band or multiplexed sweep is selected either manually by means of the front panel selector or via the remote signals, the value of K is 0. This condition will set the DPDT switch K1 in the position B-B and connect the VT (IN) signal to the inputs of the comparator and composite

Figure 4-18. Combination Logic

Mode Switch		Input				Output	
	A	W	T	A_m	M	Q_A	K
For All Positions	X	X	X	A_m	O	A_m (±5V)	1
.01 - 1 GHz	1	0	X	1	1	−5V	1
1 - 2 GHz	0	0	X	1	1	+5V	1
W. B.	1	1	T	1	1	T (±5V)	0
Remote .01 - 1 GHz	1	0	X	1	1	−5V	1
Remote 1 - 2 GHz	0	0	X	1	1	+5V	1
Remote W.B.	1	1	T	1	1	T (±5V)	0

Notes: 0 = ground potential
1 = open circuit or +5V
X = can be either "0" or "1"
T = Logic level at output of comparator

When 438A is plugged into a 4310A Multiband System:
A_m = Logic level from 4310A Multiband Control Unit
M = Logic level from 4310A = 0

tuning voltage generator circuit. The QA signal will not respond to the Signal T which is the output of the comparator circuit. It can be seen therefore, as the output of the comparator changes state, first one band and then the other band will be selected.

The composite tuning voltage generator is not keyed by the QA signal to generate a waveform suitable to tune the RF oscillator so that the RF frequency will be synchronous with the multiplexed display.

At the time that the comparator output changes state, many circuit functions are triggered simultaneously, some of them are not able to respond instantaneously. In order to avoid nonlinearities and recovery transients from being displayed, a swell is generated and the sweep is stopped for a short time interval to allow the circuits sufficient time to recover.

It should be noted that when the 438A is used in the 430A mainframe, the WIDEBAND mode (0.01 - 2 GHz) will not operate properly unless the ON/OFF switch on the rear panel of the 430A is in the OFF position.

4.3.9 Timing Waveforms

The sawtooth generator in the 430A begins its cycle and proceeds normally until the comparator in the 438A is triggered and changes state. This condition triggers the monostable multivibrator and causes a signal on the sweep hesitation lead to interrupt the sawtooth generator and stop the sweep for the duration of the sweep hesitation signal. Figure 4-19 illustrates the relative timing of these signals.

Synchronous with the triggering of the comparator, the V_T (out) signal is abruptly returned to 0 and remains there for the duration of the dwell. At the end of dwell, the sweep resumes and the V_T (out) signal begins a new sweep cycle.

The relationships among the various signals are combined on one chart in Figure 4-20 to show how time, horizontal sweep voltage, RF output frequency and tuning voltage to the RF oscillator are synchronized.

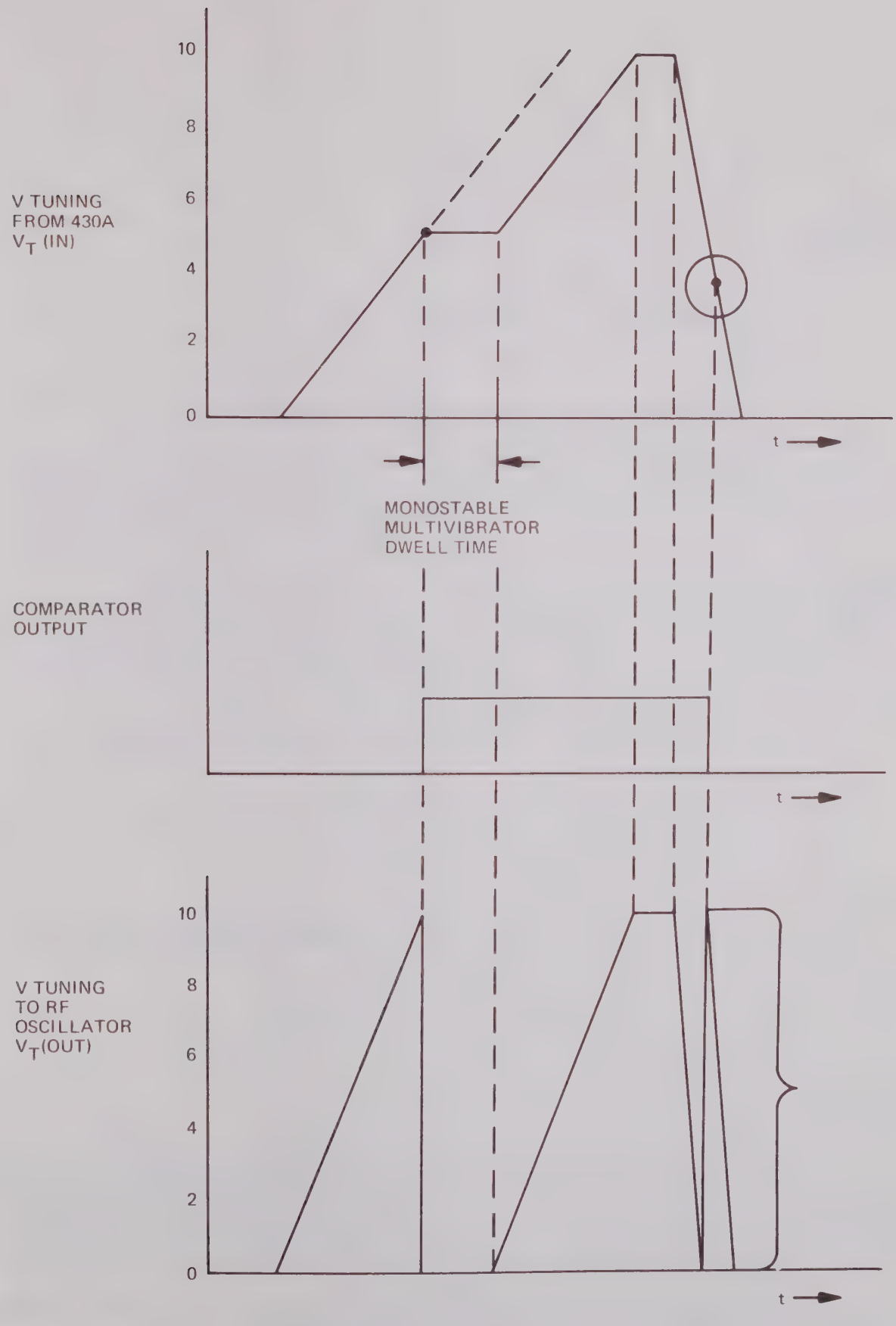


Figure 4-19. Timing Waveforms

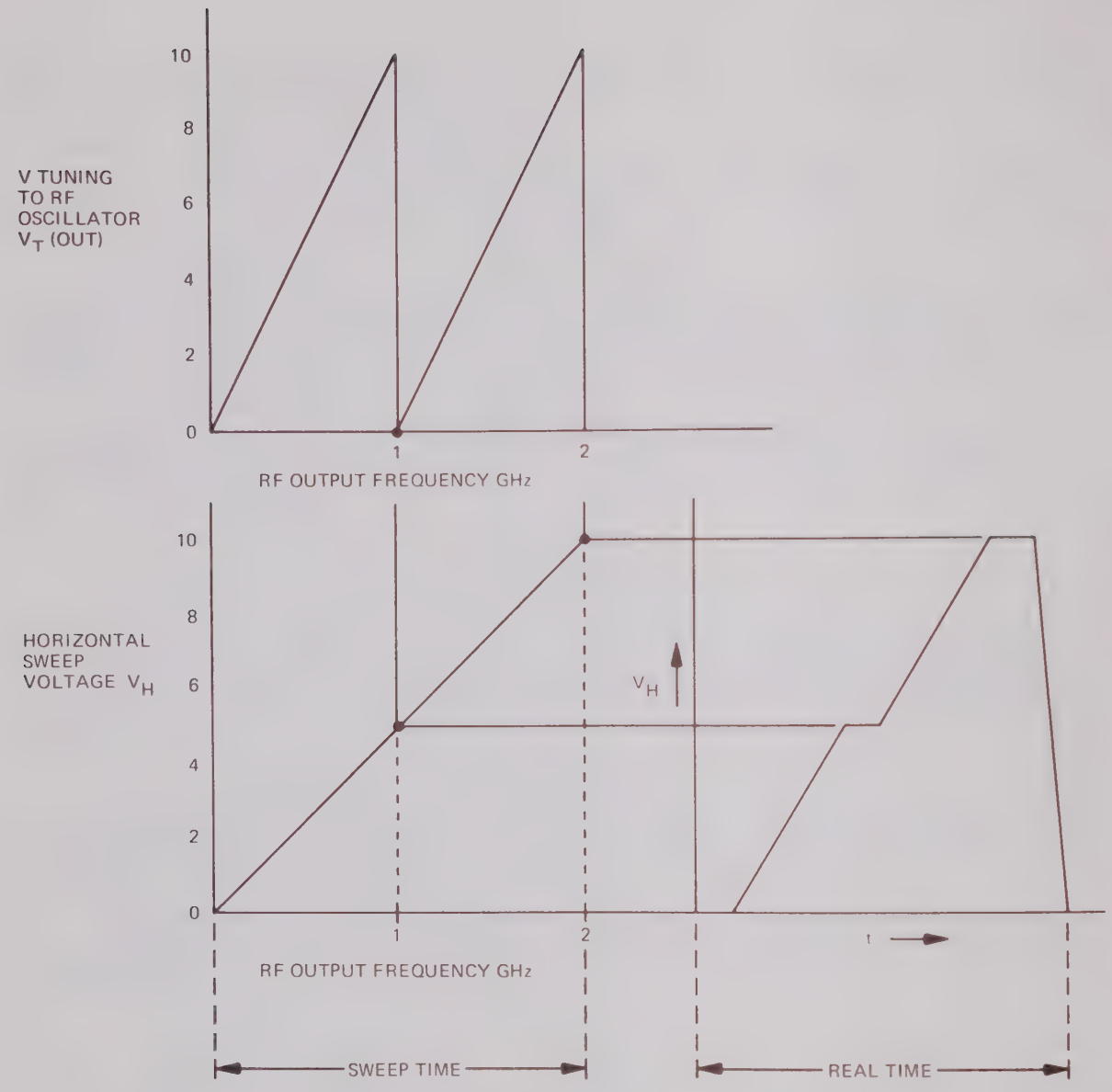


Figure 4-20. Functional Relationships

4.3.10 Comparator

The comparator circuit is shown in simplified form in Figure 4-21. When V_T (IN) is equal to 0, the net signal at the input to the amplifier is negative and the high gain of the amplifier causes it to saturate with a positive output. As V_T (IN) increases a value will be reached depending on the setting of potentiometer R47, when the net signal to the amplifier reaches zero and goes positive. In this region, the amplifier will change the polarity of its output and saturate with a negative output.

The exact value of V_T (IN) for which this transition takes place is controlled by the setting of R47 and the steepness of the transition is a function of the gain of the amplifier.

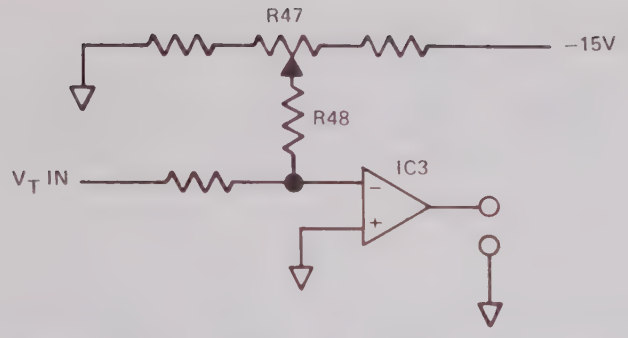


Figure 4-21. Comparator Simplified Schematic Diagram.

4.3.11 Composite Tuning Voltage Generator

The V_T (out) signal is generated by the circuit shown in Figure 4-22. Two operational amplifiers are connected in parallel and their outputs are combined in a third operational amplifier. In addition to the V_T (IN) signal, the A1 amplifier receives a bias signal from R42 and a gating signal via A4 which is an inverted and shifted version of QA. There are diodes CR4 and CR5 connected to A1 to insure that the output is always negative or zero.

A requirement of this circuit is that the full 10 volt swing of the tuning voltage V_T (OUT) be provided with the V_T (IN) signal varies over a smaller range. This corresponds to the output being an amplified version of the input. The lower limit of the output is controlled by the bias setting of R42 and the upper limit of the output is controlled by the modified QA gating signal which causes the output of A1 to return to zero when QA is present.

In a similar manner amplifier A2 is biased and gated to cause a second ramp of V_T (OUT) to occur as shown in Figure 4-19.

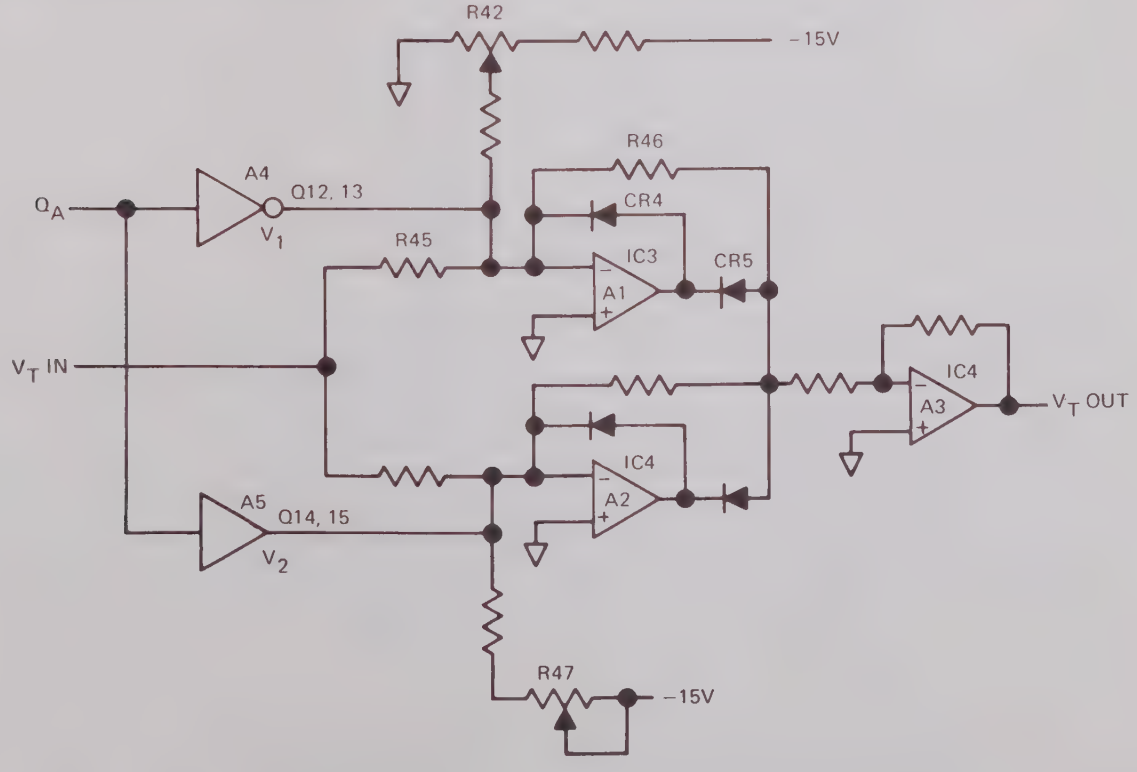


Figure 4-22. Composite Tuning Voltage Generator

4.3.12 Linearity (P/O A13, 435A/4309A, Serial No. 1994 and up)

The linearity circuitry (see Figure 4-24) compensates for any non-linearity) inherent in some Model DMSKU-12418-60 YIG sources. A typical error curve resulting from non-linearity in the frequency range of 12.4 to 18 GHz is illustrated below (Figure 4-23):

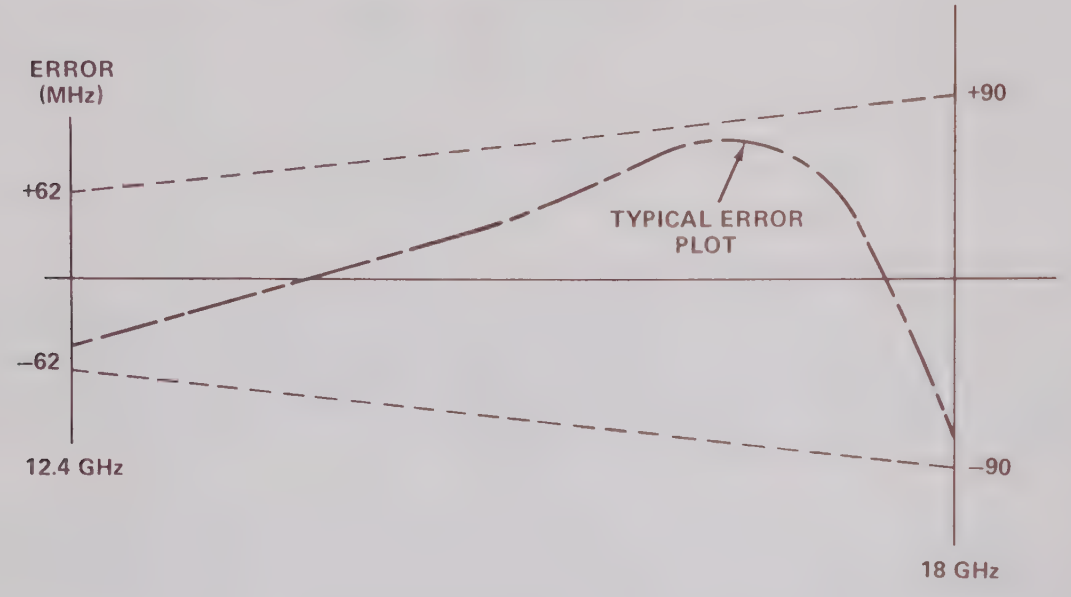


Figure 4-23. (435A/4309A, Serial 1994 and up) Nonlinearity Error Curve

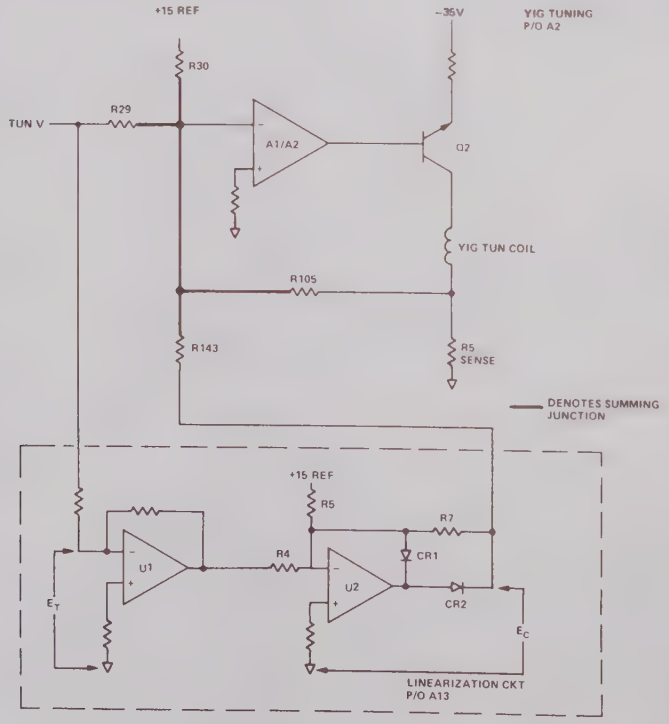


Figure 4-24. (435A/4309A, Serial 1994 and up), YIG Tunning and Linearity Circuits, Simplified Schematic Diagram

To correct the error (i.e., flatten the frequency band) requires:

a. that the offset be modified at the 12.4 GHz point to effect a zero error at this point, and

b. requires error compensation for the rapid rolloff at the near high end.

High end rolloff compensation is accomplished by the linearity circuit's control of the voltage across the A2R5 sense resistor through A2R143. Resistor A2R143 forms a summing junction at the input to the YIG tuning amplifier (A1), along with A2R105, A2R29, and reference resistor A2R30. The basic functioning of the YIG tuning circuit (P/O A2) is as described in paragraph 4.3.1 (and subordinate paragraphs). Therefore, the YIG tuning supply circuit portion of Figure 4-24 has been greatly simplified, showing only that which is relevant to the linearity circuit.

The net result of the linearity circuit output during the relatively linear portion of the YIG source is 0 volt. Resistor A13R4 is selected at test to provide the desired error correction frequency cut-in point. Figure 4-25 illustrates a comparison of the applied input tuning voltage (E_T) with the desired error correction (E_C) output from the linearization circuit. Resistor A2R143 is selected at test to provide proper slope.

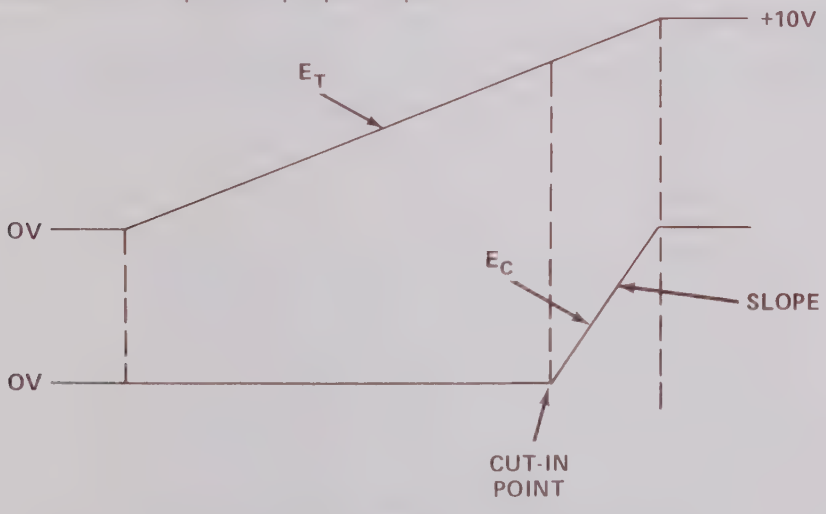


Figure 4-25. (435A/4309A Serial 1994 and up), Tuning and Error Correction Voltage Comparison

During the relatively linear portion of the YIG source (approximately 12.4 to 16.5 GHz in above error plot example), the potential at the inverting input to operational amplifier A13U2 keeps diode CR1 conducting. This potential is determined by the values of resistors A13R4 and A13R5 and the outputs of A13U1 and A13U2. (A13U1 output is inversly proportional to the input tuning voltage.) Diode CR1 clamps the output at one diode drop below the input and diode CR2 is non-conducting. Diode CR2 conducts when there is a linear relationship between input and output; this point is adjustable by selection of A13R4, diode CR1 stops conducting. From this point the output error correction (E_C) voltage rises linearily, its slope is adjustable by selection of A2R143. The tuning coil current is now proportional to the sum of the input tuning voltage and the error correction voltage (E_C).

SECTION 5
MAINTENANCE

5.1 INTRODUCTION

This section provides the information required to maintain and service the RF Units for the Model 430A Sweep Oscillator and contains a list of the required test equipment, a performance check and calibration and alignment procedures.

5.2 REQUIRED TEST EQUIPMENT

Test equipment other than those listed in Table 5-1 may be used if their specifications equal or exceed the required characteristics. (Use recently calibrated test equipnment).

5.3 PERFORMANCE TESTS

The following performance tests are performed to verify whether the RF Unit is operating within its specifications as listed in Table 1-1. The tests should be used as part of the incoming quality control inspection, as a periodic operational check or after maintenance and service has been performed.

NOTE

The RF Unit must be installed in the Model 430A Mainframe before starting the following performance tests. The 435A/4309A RF Unit is only used with the 4310A/K Multiband Control Unit, which contains its RF source. Therefore, when testing or calibrating this RF unit, the 430A or 430B and the 4310A/K must be interconnected, and the RF output must be taken from the 4310A/K. All other RF units may be calibrated in the 430B(A) chassis, as shown in Figure 5-1.

5.3.1 Frequency Accuracy

a. Connect the equipment as shown in Figure 5-1.

b. Set the Model 430A and RF Unit controls as follows:

Front Panel

TRIGGER	LINE
MARKER AMPLITUDE	Clockwise
SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	.1
F1	Low Limit
F2	High Limit
1 kHz ⎍	Off (down)
PUSH ON	Depress and Release

TABLE 5-1. REQUIRED TEST EQUIPMENT FOR PERFORMANCE AND CALIBRATION TESTS

Title	Requirements	Suggested Manufacturer and Model No.
Variable Transformer	at least 105 to 125 VAC 1 AMP	Superior Electric Co. 3PE116
Precision Digital Voltmeter	Accuracy: ±0.1% Resistance: 400K ohms, minimum Sensitivity: 1 millivolt Digits: 4-½ AC: at least 105-125 VAC ±1% 48-420 Hz	Fluke 893A
Oscilloscope	Vertical: DC to at least 300 kHz	Tektronix 5110 with 5A18M Differential Amp 1 and 5B10N Time Base
Frequency Meter, Reaction Type	±0.1% accuracy	
200 - 500 MHz		Narda 804
500 - 1000 MHz		Narda 805
0.96 - 4.20 GHz		HP-536A
3.7 - 12.4 GHz		HP-537A
12.4 - 18 GHz		HP P532A with two coaxial to waveguide adaptors
18 - 26.5 GHz		HP K532A with two coaxial to waveguide adaptors
10 dB Attenuator Pad	Calibrated within ±0.1 dB VSWR 1.3 max	Weinschel Model 44
Power Sensor	±0.3 dB	HP-8481A Power Sensor
RF Power Meter		HP-435A Power Meter
0.2 to 8.2 GHz		HP-486
8.2 to 12.4 GHz		HP X486A with coaxial to waveguide adaptor
12.4 to 18 GHz		HP P486A with coaxial to waveguide adaptor
18 to 26.5 GHz		HP K486A with two coaxial to waveguide adaptors
Directional Coupler	10 dB coupling factor	
30 to 1000 MHz	20 dB directivity	Anzac DCG10/HP 11692D
500 to 1000 MHz		
1 - 2 GHz		ARRA Model 3164-10
2 - 4 GHz		ARRA Model 4164-10
4 - 8 GHz		ARRA Model 5164-10
8 - 16.0 GHz		ARRA Model 6-9164-10
12 - 18 GHz		ARRA Model 9164-10
18 - 26.5 GHz		NARDA Model 068-10
Adjustable Length of Coaxial Line	12 inch travel	
Short Circuit		
Spectrum Analyzer		HP MODEL 8555A
Waveform Generator	±10 Volt, less than 1 microsecond rise time 10 to 1000 Hz	Exact Electronics 100
Ohmmeter	DC continuity	Fluke 8600

TABLE 5-1. REQUIRED TEST EQUIPMENT FOR PERFORMANCE AND CALIBRATION TESTS (Cont.)

Title	Requirements	Suggested Manufacturer and Model No.
Audio Oscillator	Up to 100kHz	HP-651B
Precision DC Voltmeter	±0.1% accuracy, 400 K minimum resistance 1 millivolt sensivity	Fluke 891A
Detector	1 - 18 GHz	Weinschel Model 1113
Resistor Decade Box (4 req'd)	Range: at least 5K to 75K in 1-ohm steps Accuracy: 0.5%	EICO 1171

RF	ON
If the RF Unit has Option 1 (internal leveling) set:	
LEVELER MODE	INT (depress)
RF LEVEL	Adjust fully clockwise then ccw until leveling is obtained across the entire band.
If the RF Unit does not have Option 1 set:	
LEVELER MODE	OFF (depress)
RF LEVEL	Fully cw
Rear Panel	
SWEEP RESPONSE TIME	AUTO
RF MARKERS	ON
RF DURING RETRACE	OFF

c. Set the M1 and M2 indicators at the frequencies to be checked and adjust the MARKER AMPLITUDE as desired.

d. Tune the frequency meter to make its dip coincident with each marker dip.

e. Observe that the frequency indicator and the frequency meter indications fall within frequency accuracy limits of the RF Unit specifications. If they do not, refer to the calibration procedure in paragraph 5.4.

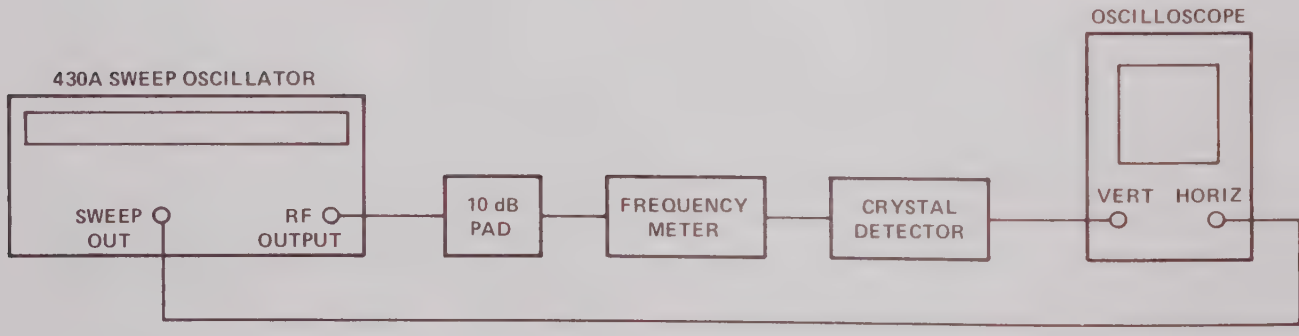


Figure 5-1. Frequency Accuracy Measurement Test Setup.

5.3.2 Spurious Signals

a. Connect the RF OUTPUT to the spectrum analyzer input. A 10 dB attenuator pad should be used to avoid burn-out of the spectrum analyzer input.

b. Set the SWEEP OSCILLATOR controls as follows:

M1	Midband (or any specific frequency to be investigated)
SWEEP FUNCTION	CW M1

1 kHz ⊓⊔	Off (down)
RF LEVEL	Fully clockwise

c. Observe the amplitude at the desired RF frequency, and at any spurious and harmonic frequency of interest. Follow the manufacturer's directions to distinguish spurious responses of the analyzer from those of the SWEEP OSCILLATOR

d. The unwanted responses should conform with Table 1-1 of this instruction manual.

5.3.3 Frequency Stability

Stability tests should be conducted in a temperature stable location free from drafts. Equipment warm-up of at least 15 minutes should be completed prior to measurements.

5.3.3.1 △F vs. 40 dB Change in RF Level

a. Connect the equipment per Figure 5-2. A high resolution frequency meter may be substituted for the spectrum analyzer.

b. Set the Model 430A and RF Unit controls as follows:

M1	Midband (or any specific frequency to be investigated)
SWEEP FUNCTION	CW M1
1 kHz ⊓⊔	Off (down)
RF LEVEL	Fully clockwise
LEVELER MODE	INT or OFF

c. Observe the power in dB, and the RF frequency indication. Reduce the power by 40 dB via the RF LEVEL control.

d. Note the change in frequency indication. It should not exceed the specification of the unit as given in Table 1-1.

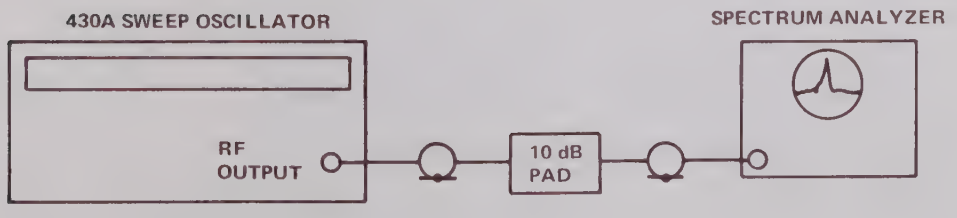


Figure 5-2. △F vs. 40 dB Change in RF Level Test Set-Up.

5.3.3.2 △F vs. 3:1 Load VSWR

a. Connect the equipment as shown in Figure 5-3.

NOTE

The combined insertion loss of the coupler and pad in the *main* line is to be 3 dB. Thus a 3 dB coupler and no pad or a 10 dB coupler and a 2½ dB pad are suitable combinations.

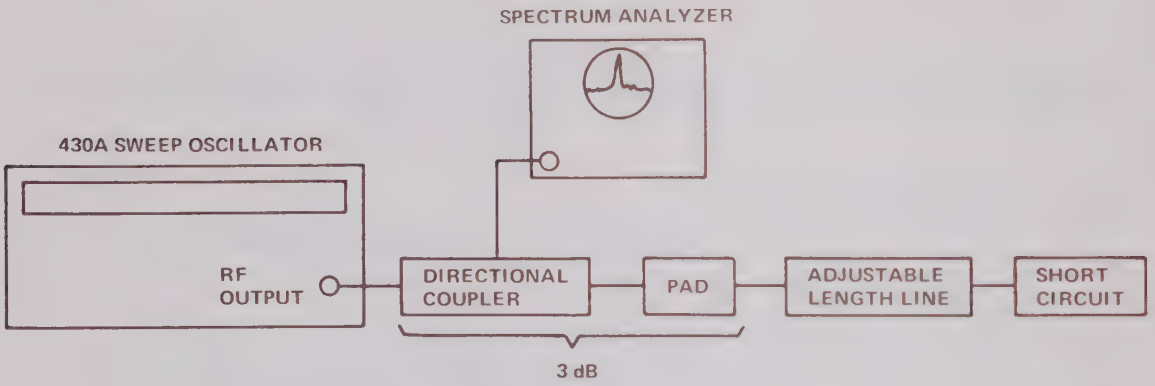


Figure 5-3. △F vs. 3:1 Load VSWR Test Set-Up.

b. Set the SWEEP OSCILLATOR controls as described in section 5.3.3.1.

c. Observe the peak-to-peak change in frequency indication as the adjustable length line is varied over at least a ½ wavelength. Divide by two to get peak △f.

d. The maximum allowable results should be within the specification as indicated in Table 1-1.

5.3.3.3 △F vs. ±10% Line Voltage-Change

a. Connect the equipment as shown in Figure 5-4.

b. Set the Model 430A controls per paragraph 5.3.3.1.

c. Adjust the ac line input over the range 105 to 125 volts rms (or 210 to 250 if applicable). Note the peak-to-peak change in frequency indication. Divide by two.

d. The maximum allowable result is given in Table 1-1.

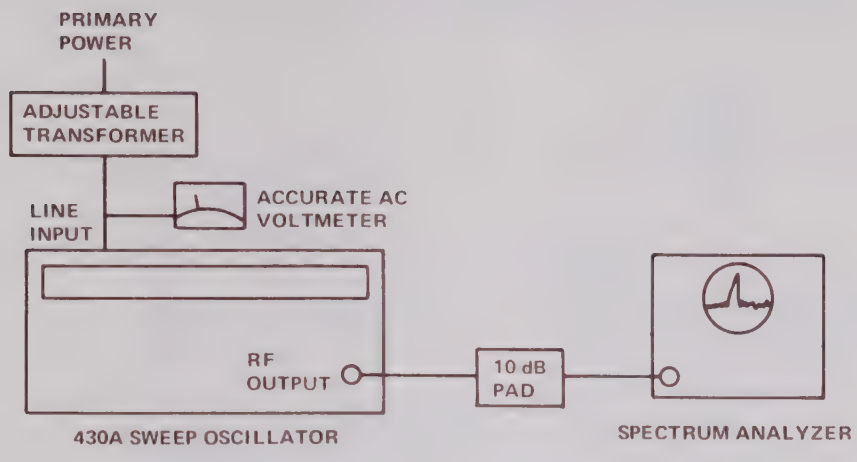


Figure 5-4. △F vs. ±10% Line Change Test Set-Up.

5.3.3.4 Frequency Modulation

a. Connect the equipment as shown in Figure 5-5.

b. Set the Model 430A controls as follows:

SWEEP FUNCTION	SYM-M1
SWEEP TIME	MAN
SYM SWEEP WIDTH	Fully ccw
M1	Center of range
SWEEP RESPONSE TIME	FAST

c. Set the audio oscillator at 100 kHz and the appropriate amplitude listed below.

431A/438A	4V pk-pk
432A	2V pk-pk
433A	1V pk-pk
434A	0.91V pk-pk
435A or 435A/4309A	0.70V pk-pk
436A	0.47V pk-pk
442A	1.60V pk-pk
444A	0.80V pk-pk

d. Set the spectrum analyzer controls as follows:

IF Bandwidth:	100 MHz
Scan Width/Div:	10 MHz
Scan Time:	50 msec

e. Observe the spectrum analyzer display for a pk-to-pk deviation within the RF Unit specifications.

f. Decrease the frequency of the Audio Oscillator down to zero and note that the pk to pk deviation remains within the RF Unit specifications.

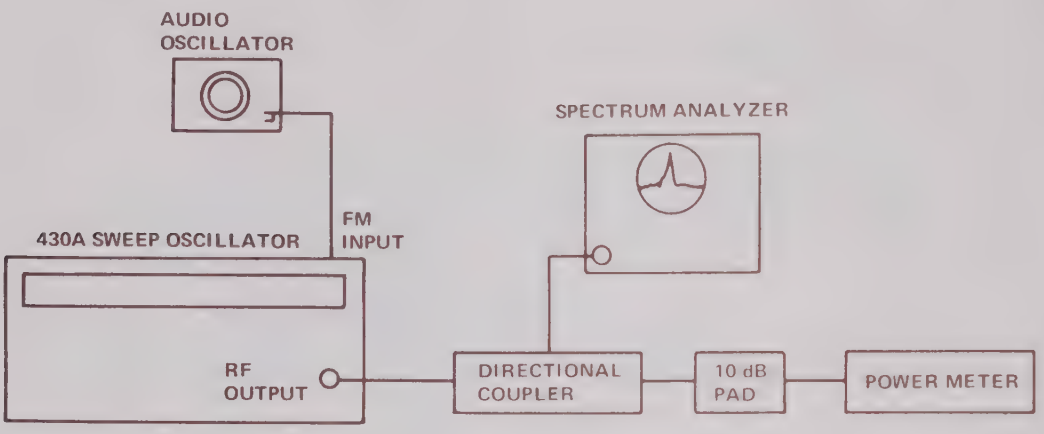


Figure 5-5. Frequency Modulation Test Set-Up.

5.3.4 Power Output (Unleveled)

a. Connect the power meter to the RF OUTPUT connector through a 10 dB pad. Do no use intervening cabling.

b. Set the Model 430A and RF Unit controls as follows:

SWEEP FUNCTION	CW M1
1 kHz ⊓⊔	Off (down)
RF LEVEL	Fully cw
LEVELER MODE	OFF

c. Adjust the M1 control across the band and note the minimum output power level indicated on the power meter.

NOTE

Power meter and pad calibration factors must be taken into account when checking the power output level.

d. The minimum power indication should be equal to or higher than the minimum power output level (mW) as specified in the RF Unit specifications.

5.3.5 Power Variation (Leveled) (only for RF Units having -1, internal leveling)

5.3.5.1 Internal Leveling*

a. Connect a power meter to the RF OUTPUT connector through a 10 dB pad. Do not use intervening RF cabling.

b. Set the Model 430A and RF Unit controls as follows:

MARKER AMPLITUDE	Fully ccw
SWEEP FUNCTION	F1 - F2
SWEEP TIME	MAN
F1	Low end of band
F2	High end of band
1 kHz ⊓⊔	Off (down)
LEVELER MODE	INT

c. Simultaneously adjust the RF LEVEL control ccw just enough to keep the unleveled indicator OFF while rotating the SWEEP TIME (SEC) VARIABLE control through its entire range and note maximum and minimum power levels (dB) as indicated on the power meter.

d. The total power variation observed in step c should be less than the total variation specified for the RF Unit. The pad calibration value must be taken into account.

5.3.5.2 External Leveling

a. Connect the equipment as shown in Figure 5-6.

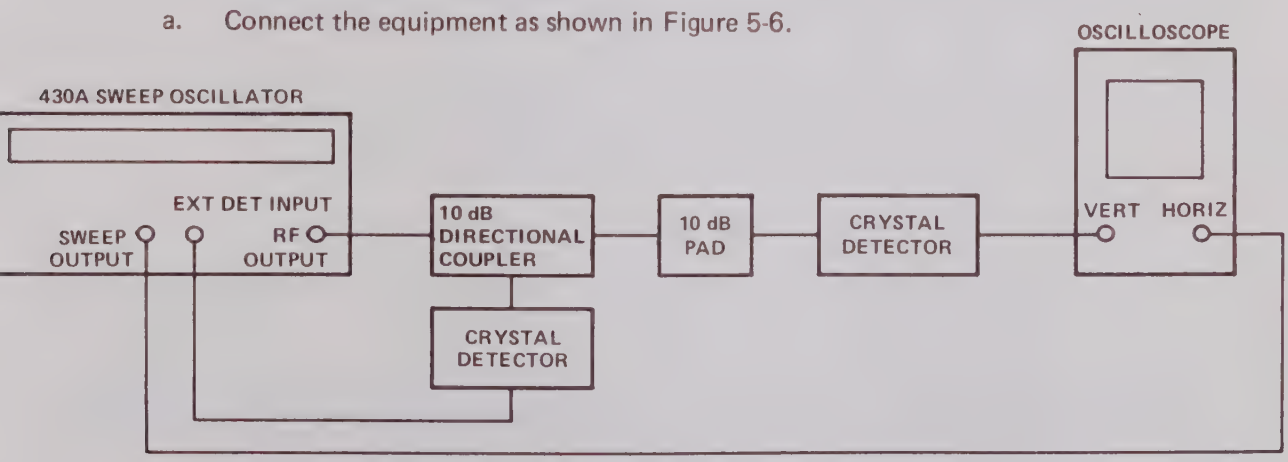


Figure 5-6. External Leveling Measurement Test Setup.

*RF Units with -1 option (internal leveling) have a slightly lower minimum output level than those units which do not include the option.

b. Set the Model 430A and RF Unit controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	F1 - F2
SWEEP TIME (SEC)	.01
F1	Low end of band
F2	High end of band
1 kHz ⊓⊔	Off (down)
SWEEP RESPONSE TIME	FAST
LEVELER MODE	EXT XTAL

c. Adjust the RF LEVEL control over its range and then rotate it ccw just enough to obtain leveling across the entire band making sure that the UNLEVELED indicator remains OFF.

d. Replace the oscilloscope and crystal detector with an RF Power Meter as shown in Figure 5-7.

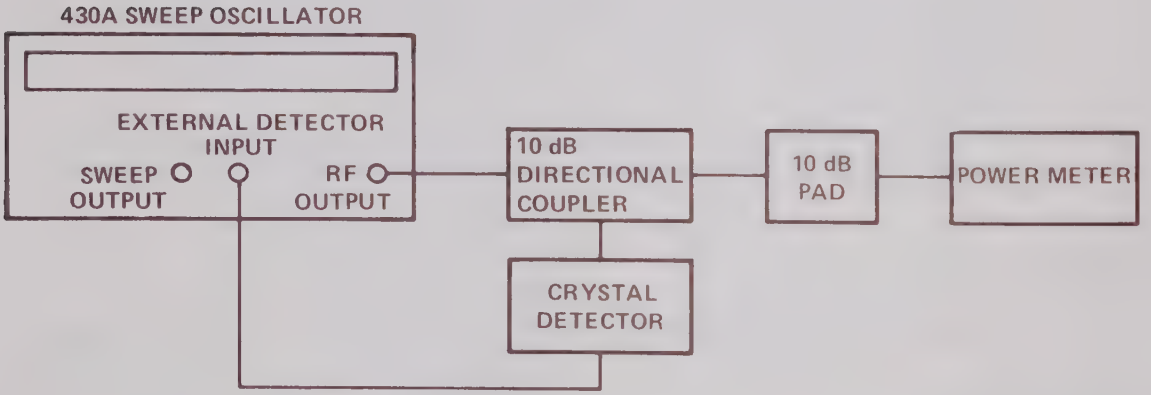


Figure 5-7. External Leveling Measurement Test Setup (2).

e. Set the SWEEP TIME control to MAN.

f. Rotate the VARIABLE SWEEP TIME control through its entire range and note the maximum and minimum power meter indications (dB).

g. The total power variation observed in step f should be less than the total variation specified for the RF Unit. The effect of the external crystal detector in addition to the 10 dB pad and external directional coupler variation must be taken into account.

5.3.5.3 Power Meter Leveling

a. Connect the equipment as shown in Figure 5-6 with the following exceptions: substitute a power meter (HP Model 432A recommended) for the crystal detector and connect the DC output (recorder output) to the EXT DET INPUT on the Model 430A.

b. Set the Model 430A and RF Unit controls as follows:

MARKER AMPLITUDE	Fully ccw
SWEEP FUNCTION	F1 - F2
SWEEP TIME	MAN
F1	Low end of band
F2	High end of band
1 kHz ⊓⊔	Off (down)
LEVELER MODE	EXT
XTAL/PWR METER	Slide switch set to PWR MTR

NOTE

Because the thermal response of the power meter is relatively slow the leveling loop bandwidth in the power meter leveling mode will be considerably less than the bandwidth in the XTAL mode. Therefore, it is necessary to sweep slowly (< 1 SWEEP/SEC) in order not to exceed the bandwidth of the leveling loop.

c. Adjust the RF LEVEL control over its range and then rotate it ccw just enough to obtain leveling across the entire band making sure that the UNLEVELED indicator remains OFF. The front panel GAIN adjust is functional only in the POWER METER mode, since the gain is automatically adjusted when in the XTAL mode, and may have to be adjusted accordingly for the particular power meter being used.

d. Rotate the VARIABLE SWEEP TIME control through its entire range and note the maximum and minimum power meter indications (dB).

e. Maximum power variation should be less than ± 0.1 dB, excluding directional coupler and crystal detector sensistivity.

f. Return XTAL/PWR Meter slide switch to XTAL position.

5.3.6 Internal Square Wave

5.3.6.1 Unleveled

a. Connect the equipment as shown in Figure 5-1 except that the frequency meter may be omitted and the 10 dB pad is connected directly to the crystal detector. Also, remove the cable between the SWEEP OUTPUT on the Model 430A and the horizontal input on the oscilloscope.

NOTE

The output of the crystal detector (connected to the oscilloscope) should be shunted by a resistor of approximately 1000 ohms to reduce the time constant of the crystal detector.

b. Set the Model 430A and RF Unit controls as follows:

1 kHz ⊓⊔	ON
RF LEVEL	Fully ccw
LEVELER MODE	OFF

c. Using the oscilloscope time base, measure square wave rise time, fall time and period. Both rise and fall times should be 10 microseconds maximum. The period should be adjustable from less than 950 to more than 1050 microseconds; symmetry within 60:40.

5.3.6.2 Leveled

a. If the RF Unit has Option-1, use the same equipment setup as used in 5.3.6.1 and set the Model 430A controls and RF Unit controls as follows:

LEVELER MODE	INT
1 kHz ⊓⊔	ON
RF LEVEL	Rotate ccw until UNLEVELED indicator just goes OFF.

b. If the RF Unit does not have Option 1, set the controls as described in step (a) except that the LEVELER MODE must be set to EXT.

c. Connect equipment as shown in Figure 5-6.

d. Using the oscilloscope time base, measure both rise and fall time and symmetry. Rise and fall time should each be 10 microseconds maximum; symmetry within 60:40.

5.3.7 External AM

a. Connect equipment as shown in Figure 5-6.

b. Set the Model 430A and RF Unit controls as follows:

1 kHz ⊓⊔	Off (down)
RF LEVEL	Mid range (approximate)
LEVELER MODE	OFF

c. Connect the output from a square wave generator to the rear panel AM Input. Adjust amplitude so that a further increase does not increase the RF amplitude. A positive voltage increases the output power if the RF LEVEL control is not fully counterclockwise, while a negative voltage decreases the output power.

d. Rise and fall time should not exceed 10 microseconds; maximum amplitude into the AM Input connector should not exceed either +10 or −10 volts.

e. Set the 430A and RF Unit controls as follows:

1 KHz ⊓⊔	INT
LEVELER MODE	Off (down)
RF LEVEL	Fully cw

f. Repeat step c and check that rise and fall time does not exceed 2 microseconds.

5.3.8 Symmetrical Sweep Width Accuracy

a. Connect the equipment as shown in Figure 5-1.

b. Set the Model 430A and RF Unit controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	SYM M1
SWEEP TIME (SEC)	.1
M1	Center of band
RF LEVEL	Fully cw
LEVELER MODE	OFF
SWEEP RESPONSE TIME	AUTO

c. At each setting of the SYMMETRICAL SWEEP WIDTH control to be checked (depending on RF Unit) tune the frequency meter to both the high and the low end of the frequency range being swept and note the two different frequency readings.

d. The difference between the two frequency meter readings and the corresponding frequency limits of the calibrated settings of the SYMMETRICAL SWEEP WIDTH control should be within the specifications for that RF Unit.

5.3.9 Residual FM

NOTE

If a spectrum analyzer is not available, residual FM may be checked as outlined in paragraph 5.3.10.

a. Connect the equipment as shown in Figure 5-4.

b. Establish a power reference level on the spectrum analyzer at the lowest stable settings of the spectrum analyzer controls.

c. Measure the pk to pk frequency spectrum at -3 dB down from the power reference level.

d. Divide this reading by two; it should be less than that specified for the RF Unit.

5.3.10 Residual FM (Alternate Method)

a. Connect the equipment as shown in Figure 5-1.

b. Set the Model 430A controls as specified in paragraph 5.3.8, step b, except for the RF LEVEL control which is rotated fully clockwise.

c. Calibrate the frequency meter as a function discriminator as follows: Tune the frequency meter so that its dip is centered in the oscilloscope display as shown in Figure 5-8. Place a straight edge on the display and measure the maximum slope of the frequency meter dip. Divide the vertical measurement to obtain the discriminator constant in millivolts/kHz.

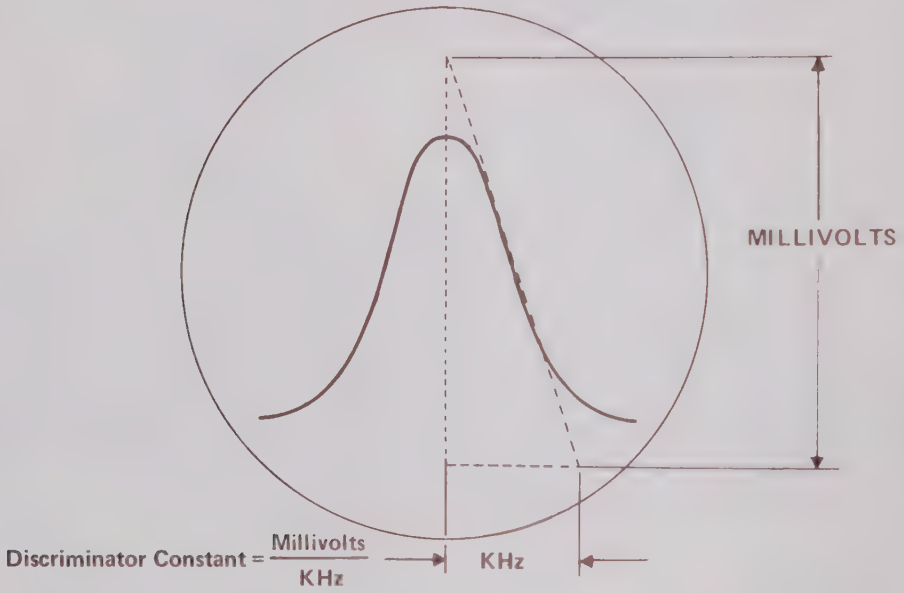


Figure 5-8. Slope Discriminator Display.

d. Set the SWEEP FUNCTION switch to SYM M1.

e. Set the SWEEP TIME (SEC) switch to MAN and rotate the VARIABLE (vernier) control fully counterclockwise.

f. Rotate the SYMMETRICAL SWEEP WIDTH control (on RF Unit) fully counterclockwise for narrowest sweep width.

g. Increase the oscilloscope vertical sensitivity and tune the frequency meter for maximum peak-to-peak vertical amplitude. The oscilloscope time base should be used. Record the peak-to-peak amplitude.

h. Divide the peak-to-peak amplitude figure by the discriminator constant to obtain kHz peak-to-peak. Then divide by 2 to obtain peak residual FM. This should not exceed the specification for the RF Unit being used.

NOTE

To ensure that the auto bandwidth circuitry is functioning properly, place the SWEEP RESPONSE TIME slide switch (on rear panel) to FAST. The residual FM should increase. Then set the switch back to AUTO. Within a few seconds, the residual FM should decrease to its minimum value indicating that the bandwidth has been reduced.

5.3.11 Proportional Sweep Amplitude

a. Connect the PROPORTIONAL OUTPUT to the oscilloscope vertical input.

b. Set the Model 430A controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	.1
F1	Lower limit
F2	Upper limit
PROPORTIONAL	10V/BAND

c. The PROPORTIONAL OUTPUT voltage should start at + 0.25 (± 0.25) volts and finish at + 9.75(± 0.25) volts.

d. Set the rear panel PROPORTIONAL switch to 40 V/OCTAVE.

e. The PROPORTIONAL OUTPUT voltage should not start at + 1 (± 1) volt and finish at + 40 (± 3) volts for RF Units covering a full octave. The 434A and the 435A RF, 436A, 442A and 444A Units do not cover a full octave and therefore the end frequency voltage will be proportionally less.

5.4 CALIBRATION PROCEDURE

In the following paragraphs, reference is made to Test Points. As an aid in locating these points, use Figures 5-9A through 5-9C which show their general location on each board.

NOTE

The 435A/4309A RF unit is only used with the 4310A/K Multiband Control Unit, which contains its RF souce. Therefore, when calibrating the 435A/4309A, the 430B(A) and the 4310A/K must be interconnected and the RF output must be taken from the 4310A/K. All other RF Units may be calibrated in the 430B(A) chassis, as shown in Figure 5-1. In a 4310A/K Multiband Sweeper System, the various RF Units shold be "extended" from their normal system positions, as shown in the 4310A/K manual.

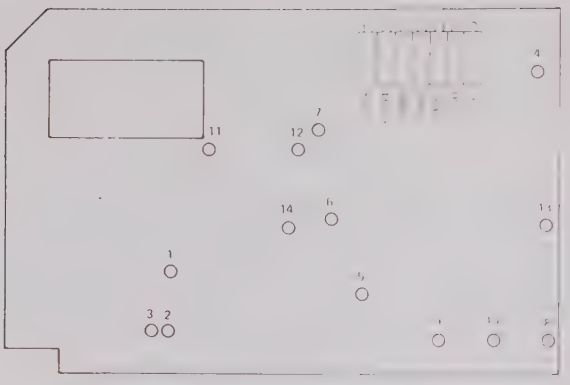


Figure 5-9A. Test Point Map of Board A2 (YIG Tuned RF Units Only)



Figure 5-9B. Test Point Map of Leveler Board (A1)

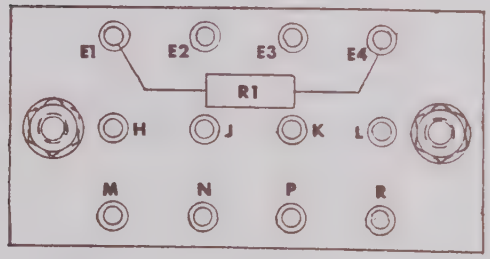


Figure 5-9C. Test Point Map of Auxiliary Termination Board A3

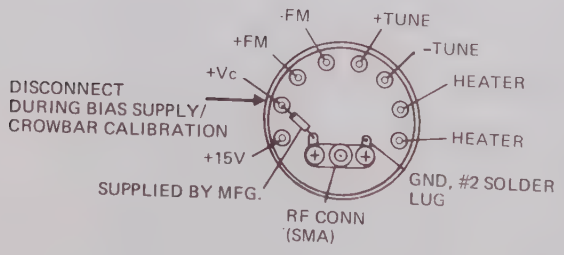


Figure 5-9D. RF YIG Pin Location Diagram

5.4.1 Bias Supply/Crowbar Calibration

It is extremely important to check and calibrate the bias supply and crowbar circuit when the RF source is replaced. Two bias adjustment procedures are provided in the paragraphs below. The first procedure (5.4.1.2) is used for sources that require adjustment of the bias voltage at both ends of the frequency band (Bias Voltage Programming). These include sources made by Varian, Watkins-Johnson, Avantek and Weinschel that are used in the following RF Units: 432A, 433A, 434A, 435A, 442A and 444A. The RF Source Data sheet provides the necessary information for bias voltage programming. For Avantek sources, the presence of a listed bias voltage indicates the need for bias voltage programming. For other sources, the presence of a listed bias voltage for each end of the frequency band indicates a need for bias voltage programming. For Avantek sources with no listed bias voltage or other sources with only one frequency bias voltage, or for sources in RF Units not listed above, the simpler bias-setting procedure of 5.4.1.3 may be used.

NOTE

If the RF source has been replaced, the protective SCR crowbar circuit must first be readjusted for the bias characteristics of the new source. Perform the crowbar circuit adjustment procedure outlined in 5.4.1.1. (If the RF source has *not* been replaced, the crowbar circuit need not be adjusted, so proceed directly to 5.4.1.2 or 5.4.1.3, as appropriate.

CAUTION

Disconnect the bias supply for the RF source at terminals M and N of board A3 before proceeding. (The Model 438A has no A3 boards, so disconnect the white/yellow wire attached to the second terminal clockwise from the RF output port of the RF source. See Figure 5-9D. For the Model 435A/4309A only, the bias supply can be disconnected by removing the interconnecting cable from J1 on the 435A/4309A unit to J1 on the 4310A/K units).

a. Connect the RF Unit to the 430B(A) Mainframe with an extender cable, as shown in Figure 5-12.

b. Set the 430B(A) controls as follows:

TRIGGER: Auto
SWEEP FUNCTION: CW-M1
SWEEP TIME: .01 sec
SWEEP TIME VARIABLE: CW
F1: Low Mechanical Limit
F2: High Mechanical Limit
M1: Nominal Low End of Band
M2: Nominal High End of Band
1 kHz: Off
MARKER AMPLITUDE: Center
SWEEP RESPONSE TIME: Auto
RF During Retrace: Off
MARKERS: On
PROPORTIONAL OUTPUT: 40V/Octave
MARKERS CAL.REL: Calibrated
JUMPER SWITCH: On
POWER: Off

If the RF Unit is being calibrated as part of a 4310A/K Multiband system, the JUMPER SWITCH should be OFF, and the appropriate band selected.

5.4.1.1 Crowbar Circuit Adjustment

a. Connect a voltmeter at A2TP3 and A2TP2 (GND).

b. Adjust A2R18 to increase the bias supply voltage until the protective SCR crowbar circuit trips, dropping the bias voltage to approximately 0.5 to 1.5V. Immediately switch the RF ON/OFF switch to OFF.

NOTE

The crowbar circuit should trip at 5% to 6% above the highest normal bias voltage, but not to exceed the maximum allowable voltage as specified by the RF source manufacturer. For RF Units with Avantek RF Sources that require programmed bias voltage, the crowbar should be set to trip at + 16.5V, -0V.

If adjustment of A2R18 cannot increase the bias sufficiently to trip the crowbar circuit, return A2R18 fully ccw, place a jumper across A2R9, then turn A2R18 cw to achieve the desired level.

c. If the crowbar circuit does not trip at the correct voltage, A2R10 must be selected experimentally, using a decade box with short leads, for the correct value. A 0.01 µF capacitor may be connected across the test leads to avoid false-tripping of the crowbar circuit.

d. When the crowbar adjustment is complete, remove the jumper (if any) and restore R18 to a mid-range setting.

5.4.1.2 *Bias Voltage Programming*

a. Connect a voltmeter at A2TP3, and A2TP2 (GND).

NOTE

For the 435A/4309A RF Unit only, the bias voltage should be monitored directly at the RF source bias terminals, due to voltage drop between the A2 board in the RF Unit and the RF source in the 4310A/K. On earlier Kµ-band sources, the bias terminals are designated "V_B + , V_B – ", and on later sources are designated "DIODE + , DIODE – ".

CAUTION

Switch the power OFF before changing A2R8, to prevent damage to A2C5.

b. Insert decade resistance boxes in place of A2R8 and A2R139, set to open circuit.

c. Set the value of the A2R8 decade box to produce the correct bias voltage for the low end of the frequency band.

d. Calculate the correct value for A2R139 as follows, but leave the decade box open at this time.

$$A2R139 = \frac{A2R8\,(11.026)}{V_{B^1} - V_{B^2}} \times 1.24 \text{ (for an increasing voltage with frequency)}$$

or

$$A2R139 = \frac{A2R8\,(11.026)}{V_{B^1} - V_{B^2}} \times 1.45 \text{ (for a decreasing voltage with frequency)}$$

e. The programmed bias voltage ramp is generated by a circuit on Auxiliary Board A12 (refer to schematic, Figure 7-19) and supplied to bias regulator at A2-52. Check for a -12V ramp (432A, 433A, 442A) r a + 12V ramp (434A, 435A, 435A/4309A, 436A, 444A) at A2-52.

f. Set the A2R139 decade box to the value calculated above. Tune M1 to the high end of the band. If the bias voltage is correct, turn the 430B(A) power OFF, and install resistors equivalent in value to the A2R8 and A2R139 decade boxes.

g. If the high frequency bias voltage is incorrect, change the value of the A2R139 decade box to produce the correct bias voltage.

h. Tune M1 back to the low end of the band and adjust A2R8 (if necessary) to produce the correct low frequency bias. Repeat steps (c) and (g) to achieve correct bias at both ends of the band. Trimmer R18 may be used in this process. Turn the power OFF and install the correct value resistors for A2R8 and A2R139.

i. Turn the RF unit ON and OFF several times and check that the crowbar circuit does not trip with the proper bias voltage.

5.4.1.3 Bias Voltage Adjustment

NOTE

If Bias Voltage Programming (5.4.1.2) has been performed, this step is not necessary.

a. Connect a voltmeter to A2TP3 and A2TP2 (GND).

b. Check that A2R8 is the correct value for the RF Source bias voltage (V_b), as specified on the RF Source Data Sheet. Calculate A2R8 as follows:

$$A2R8 = V_b \times 1000\Omega$$

c. Turn the 430B(A) power ON. Check for the approximate correct bias voltage at A2TP3.

d. Adjust A2R18 to produce the correct bias voltage.

e. Turn the RF unit ON and OFF several times and check that the crowbar circuit does not trip with the proper bias voltage.

5.4.2 Tuning Supply

a. Primary Loop Calibration (Except 435A/4309A)

1. Connect the equipment as shown in Figure 5-12.
2. Set the Model 430A and RF Unit controls as follows:

Front Panel

TRIGGER	Auto
MARKER AMPLITUDE	Clockwise
SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	.1
VARIABLE	Fully ccw
F1	Low Limit
F2	High Limit
1 kHz	Off (down)
PUSH ON	Depress and Release
RF	On
If the RF Unit has Option 01(internal leveling) set:	
LEVELER MODE	INT (Depress)
RF LEVEL	Adjust ccw until leveling is obtained across entire band.
If the RF Unit does not have Option 01, set:	
LEVELER MODE	Off
RF LEVEL	Fully ccw

Rear Panel

SWEEP RESPONSE TIME	Auto
RF MARKERS	On
RF During Retrace	Off

3. Set the M1 and M2 indicators at the low end calibrated limit and the high end calibrated limit (i.e. 2.0 and 4.0 GHz) respectively.
4. Set the frequency meter to the low limit (i.e. 2.0 GHz).
5. Adjust A2R31 (PRIMARY LOOP OFFSET) to make the frequency meter dip coincide with the marker.
6. Set the frequency meter to the high end limit (i.e. 4.0 GHz).
7. Adjust A2R104 (PRIMARY LOOP TRACKING) to make the frequency meter dip coincide with the marker.
8. Since there is some interaction between controls A2R31 and A2R104, repeat steps 4 through 7 until no further adjustments are required.

b. Secondary Loop Calibration

1. Connect the oscilloscope to A2TP10 and set the sweeper controls as follows:

SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	0.1
VARIABLE	Fully cw

2. Place a jumper across A2CR42.
3. Observe the oscilloscope display shown in Figure 5-10.
4. Adjust A2R89 (SECONDARY LOOP OFFSET) so that amplitude B is equal to approximately 1/8 of the amplitude of A.
5. Remove jumper across A2CR42 adn observe the display return to normal as shown in Figure 5-11.
6. Connect the oscilloscope to A2TP9.
7. Adjust A2R108 (SECONDARY LOOP TRACKING) to obtain a horizontal line.

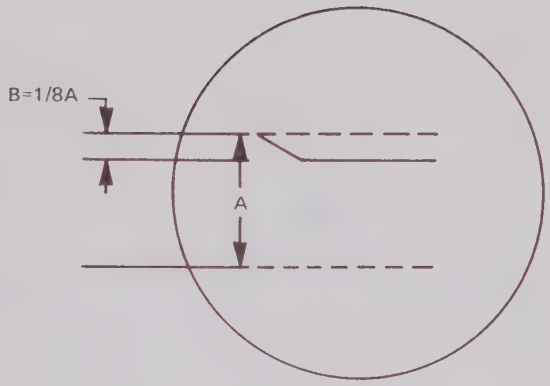


Figure 5-10. Oscilloscope Display, Offset (Negative Crystal)

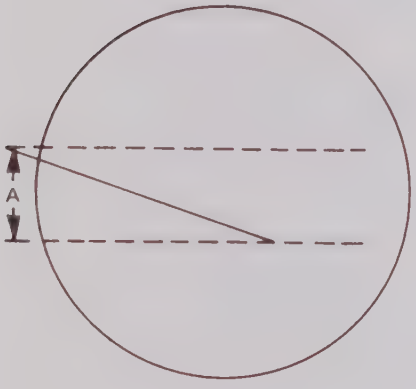


Figure 5-11. Oscilloscope Display, Ramp (Negative Crystal)

c. YIG Lag Compensation

1. Reconnect the oscilloscope as shown in Figure 5-12 and set controls as indicated in step a.2.

2. Set the frequency meter dip to coincide with the high end frequency marker (i.e., 4 GHz).

3. Switch the SWEEP TIME (SEC) control to .01 and observe the shift in relative position between wavemeter dip and marker. Adjust A2R50 YIG COMPENSATION so that minimum relative shift is observed.

d. High Frequency Clamp

1. Set the Model 430A and RF Unit controls as follows:

Front Panel

TRIGGER	Auto
MARKER AMPLITUDE	Clockwise
SWEEP FUNCTION	SYM M1
SWEEP TIME (SEC)	.1
VARIABLE	Fully cw
F1	Low Limit
F2	Max. cw
1 KHz	Off (down)

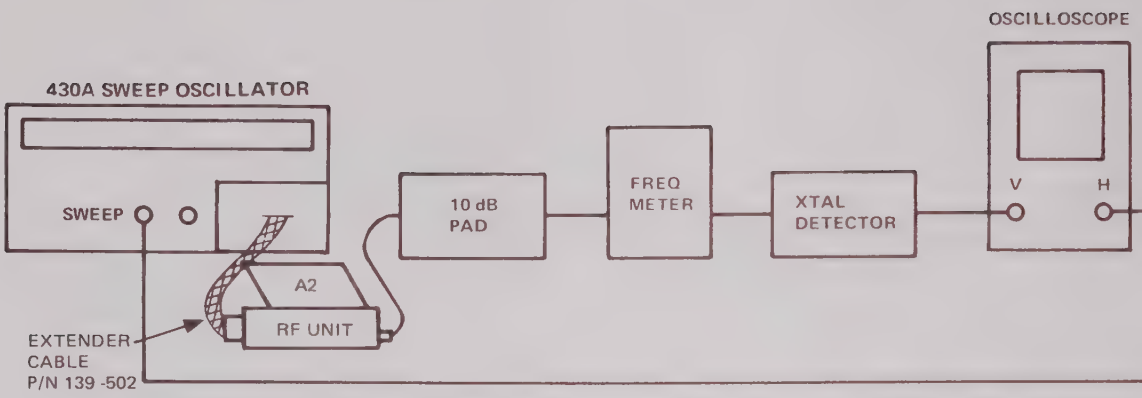


Figure 5-12. Primary Loop Calibration and High Frequency Clamp Test Set-Up

PUSH ON	Depress and Release
M1	2/3 Full Scale
SYM SWEEP SWITCH	Switch fully cw
ON RF UNIT	Variable fully cw
RF	ON
LEVELER MODE	OFF (Depress)
RF LEVEL	Fully cw

Rear Panel

SWEEP RESPONSE TIME	AUTO
RF MARKERS	ON
SYM MARKERS	CALIBRATED

2. Set the Frequency Meter Pip slightly to the right hand side of the F2 Marker.

3. Adjust A2R87 so that Frequency Meter Pip is partially removed from the display.

e. Primary Loop and Linearity Test and Calibration (435A/4309A Only, Serial No. 1994 and up)

1. Set the Model 430A, 4310A/K and 435A/4309A controls as follows:

Front Panel

TRIGGER	AUTO
SWEEP TIME(SEC)	MAN
SWEEP FUNCTION	F1–F2
F1	Nominal low
F2	Nominal high
M1	High mechanical limit
M2	High mechanical limit
RF ON/OFF	ON
RF LEVEL	Fully cw
PUSH ON	ON

Rear Panel

RF MARKER	ON
PROPORTIONAL OUTPUT	10V/BAND

2. Connect decade resistor boxes in place of Model 435A/4309A resistors A2R30 (≈8.25K) and A2R105 (≈2.55K). (Refer to Figure 7-16 for location.)

3. Connect digital voltmeter to Model 430A rear PROPORTIONAL OUTPUT BNC connector.

4. Adjust Model 435A/4309A trimmers A2R31 and A2R104 to mid positions.

5. Connect 12.4 — 18 GHz frequency meter to RF OUTPUT connector (see Figure 5-1).

6. Rotate Model 430A SWEEP TIME (SEC) VARIABLE control fully ccw; observe voltmeter for a -0.328 ±0.025 volt reading.

7. Adjust A2R30 decade box for a reading of 12.4 GHz, ±0.5%, on the frequency meter.

8. Rotate SWEEP TIME (SEC) VARIABLE control fully cw; voltmeter should indicate -9.672, ±0.025, volts.

9. Adjust A2R105 decade box for a reading of 18.0 GHz ±0.5% on the frequency meter.

10. Repeat steps 6 through 9 until frequency accuracy of ±0.5% is achieved.

11. Set SWEEP FUNCTION selector to CW M1

12. Rotate M1 control to obtain the voltages listed in Table 5-2. For each voltage reading, record the actual frequency obtained on the frequency meter.

13. Compare the actual frequency obtained with the desired frequency listed in Table 5-2 and record the error margin. Examples of actual readings and resultant error margins are included in Table 5-2.

TABLE 5-2. FREQUENCY ERROR PLOTTING (435A/4309A only, Serial No. 1994 and up)

Voltage Obtained (±0.005V)	Desired Frequency (GHz)	Example of Frequency Error Plotting: *Actual Freq. Obtained (GHz)	*Error Margin (MHz)
-0.328	12.4	12.406	+ 6
-1.332	13.0	13.047	+ 47
-2.166	13.5	13.573	+ 73
-3.000	14.0	14.108	+108
-3.834	14.5	14.639	+139
-4.668	15.0	15.163	+163
-5.502	15.5	15.690	+190
-6.336	16.0	16.208	+208
-7.170	16.5	16.722	+222
-8.004	17.0	17.214	+215
-8.838	17.5	17.637	+137
-9.672	18.0	17.995	- 5

*NOTE: These are examples only.

14. Calculate the starting frequency for the error correction voltage as follows:

    E_C Start = F_1 + E

    where: E = Average of 3 highest error margins
    F_1 = Frequency meter reading for the highest obtained error margin.

    Referring to the Table 5-2 example

    E_C Start = 16.937 GHz

    (F_1 = 16.722 GHz + E = 215 MHz)

15. Rotate M1 control until the E_C start frequency is obtained on the frequency meter (16.937 GHz in the Table 5-2 example).

16. Record voltage reading obtained on voltmeter.

17. Turn Model 430A power off.

18. Set Model 430A front panel controls as follows:

SWEEP FUNCTION	CW M1
MARKER AMPLITUDE	Fully cw
SWEEP TIME (SEC)	.01
SWEEP TIME (SEC) VARIABLE	Fully cw

19. Connect decade resistor box in place of Model 435A/4309A resistor A13R4 (≈7K). (Refer to Figure 7-32 for location.)

20. Connect oscilloscope external trigger to Model 430A SWEEP OUT BNC connector.

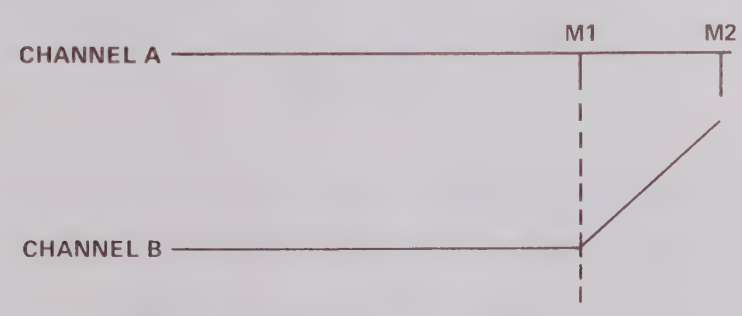
21. Connect oscilloscope channel A input to Model 430A rear VIDEO MARKER OUTPUT connector, and channel B input to Model 435A/4309A point A13E4 (see Figure 7-32).

22. Turn Model 430A power on.

23. Rotate M1 control until voltmeter indicates same voltage as obtained in step 16.

24. Set SWEEP FUNCTION selector to F1-F2.

25. Observe oscilloscope presentation and adjust A13R4 decade box until error correction voltage ramp begins at the M1 setting as shown below:



26. Set SWEEP FUNCTION selector to MAN.

27. Rotate SWEEP TIME (SEC) VARIABLE control fully ccw and observe voltmeter for -0.328, ±0.025, volt reading.

28. Rotate SWEEP TIME (SEC) VARIABLE control fully cw and then rotate F2 control until the voltmeter indicates the same voltage as was obtained in step 16.

29. Rotate SWEEP TIME (SEC) VARIABLE control back ccw and then adjust A2R30 decade box for a 12.4 GHz ±0.5% reading on the frequency meter.

30. Rotate SWEEP TIME (SEC) VARIABLE control cw and then adjust A2R105 decade box until the frequency indicated by the F2 marker (±0.5%) is obtained on the frequency meter.

31. Repeat steps 29 and 30 until frequency accuracy of ±0.5% is achieved.

32. Set F2 to the nominal high end of scale.

33. With SWEEP TIME (SEC) VARIABLE control cw, voltmeter should indicate -9.672, ±0.025, volts.

34. Connect decade resistor box in place of Model 435A/4309A resistor A2R143 (≈50K). (See Figure 7-16.) Adjust decade box until frequency meter indicates 18.0 GHz ±0.5%.

35. Remove all decade boxes and replace with appropriate fixed resistors; solder in all selectible resistors.

36. Repeat procedure to check frequency accuracy. Frequence accuracy of ±0.5% should be present across the entire band. Some adjustment of Model 435A/4309A trimmers A2R31 and A2R105 may be necessary to achieve ±0.5% frequency accuracy.

5.4.3 Leveler (Except Model 436A)

a. Connect the equipment as shown in Figure 5-13.

b. Set the Model 430A and RF Unit controls as follows:

Front Panel

TRIGGER	AUTO
SWEEP FUNCTION	F1-F2
SWEEP TIME	.01

VARIABLE	Fully cw
F1	Low end of scale
F2	High end of scale
I KHz ⊓⊔	Off
M1	Center
M2	High end of scale
LEVELER MODE	Off
RF LEVEL	Fully cw

Rear Panel

RF DURING RETRACE OFF

c. Set PWR/XTAL Switch (S2) located on Assembly A1 to XTAL position. (Forward)

d. Connect the oscilloscope to A1TP4.

e. Adjust A1R44 so that level observed on the oscilloscope is between -5 and -10 millivolts.

f. Depress INT button of LEVELER MODE to establish internal leveling.

g. Adjust RF LEVEL control so that the RF output is approximately 25% below the level at which the output is leveled across the entire band.

h. Set 1 kHz ⊓⊔ to the ON position.

i. Observing the RF output displayed on the oscilloscope, adjust A1R16 for minimum overshoot consistent with fast rise time. This adjustment should result in a rise time within specifications and less than 10% overshoot.

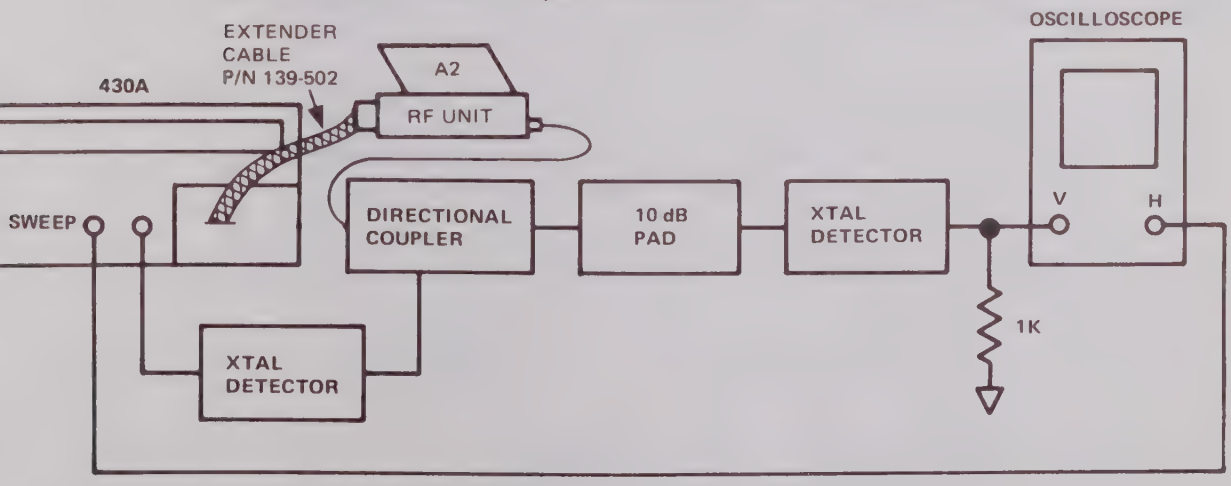


Figure 5-13. Leveling Calibration Test Set-Up

5.4.4 Model 438A Multiband Sweep Oscillator

Since the Model 438A Sweep Oscillator is a multiband sweeper, additional tests are required for band 1 of the unit (0.01 GHz to 1 GHz). The previous tests in paragraph 5.4 may be used for testing band 2 (1 GHz to 2 GHz).

5.4.4.1 High Frequency Clamp Adjustment.

This test must be done with the BAND SELECT in the .01 - 1 GHz band.

a. Connect the Model 438A RF OUTPUT through a low band wavemeter and then to an oscilloscope.

b. Set the Model 430A controls as follows:

SWEEP FUNCTION	SYM 1
SWEEP TIME	.1 SEC.
MARKER CAL/REL	CALIBRATED
M1	APPROXIMATELY 2/3 of SCALE
SWEEP TIME VARIABLE	ccw
BAND SELECT	.01 - 1 GHz
SYM SWEEP WIDTH	cw (maximum)
VARIABLE	cw (maximum)

c. Position the wavemeter signal pip approximately one small oscilloscope division to the right of the F2 marker.

d. Adjust A2R87, high frequency clamp, ccw until the signal pip of the wavemeter disappears.

5.4.4.2 Frequency Accuracy Adjustment 0.01-1GHz

a. Fixed Oscillator Adjustment—Refer to Figure 7-27 and proceed as follows:

1. Connect the Model 438A RF Unit to a Model 430A Mainframe with an extender cable and remove the cover on the Model 438A.

2. Set the Model 430A controls as follows:

TRIGGER	AUTO
SWEEP FUNCTION	CW-M1
M1	Nominal high end of scale

3. Set the Model 438A Controls as follows:

BAND SELECT	.01-1GHz
LEVELER MODE	OFF
RF LEVEL	cw
POWER SET SCREW	cw

4. Turn on power

5. Adjust tuning slug A for 1200 MHz ± .5 MHz.

NOTE

Tuning slugs B and C are set at the factory and should not be readjusted in the field.

b. 0.01—1GHz RF Output Frequency Adjustment:

1. Connect the equipment as shown in Figure 5-12.

2. Set the Model 430A controls as follows:

SWEEP FUNCTION	F1-F2
MARKER F1 and F2	200 MHz and 1 GHz (respectively)
BAND SELECT	.01-1GHz
SWEEP TIME	.1 SEC.

3. Turn the Model 430A power ON and observe the oscilloscope for a detected RF presentation.

4. Set the wavemeters to 200 MHz and 1 GHz and observe the oscilloscope display.

5. Adjust A2R136 to achieve frequency accuracy at .01 SEC. and .1 SEC.

6. SET M1 to 10 MHz and the SWEEP FUNCTION to CW-M1.

7. Disconnect the wavemeters and connect the RF OUTPUT through a 10 dB pad attenuator to a frequency counter.

8. Check the accuracy of CW-M1 at 10 MHz, 200 MHz, 500 MHz and 1 GHz.

9. Adjust A2R136 to bring the unit back within the specifications given in Table 1-2.

10. Repeat steps 4 through 9 as necessary to establish a standard setting.

5.4.4.3 Wideband (WB) Frequency Accuracy Adjustment

Proceed as follows:

a. Connect the equipment as described in paragraph 5.4.4.1 step 2.

b. Set the Model 430A controls as follows:

SWEEP FUNCTION	F1 - F2
M1	center frequency
SWEEP TIME	.1 SEC.
VARIABLE	cw (maximum)
BAND SELECT	WB

c. While observing the display on the oscilloscope, adjust A5R47, comparator adjust, until the marker is contained within the dwell at both .1 SEC and .01 SEC.

d. Set the M1 marker and wavemeter to 1.1 GHz.

e. While observing the display on the oscilloscope, adjust A5R67, the 1-2 GHz offset, until the frequency pip of the wavemeter is aligned with the M1 marker.

f. Set the M1 marker and wavemeter to 900 GHz.

g. Adjust A5R62, the .01-1 GHz offset, until the frequency pip of the wavemeter is aligned with the M1 marker.

h. Check for a smooth crossover of the wavemeter signal pip at the dwell by moving the wavemeter back and forth across the 1 GHz point. (It may be necessary to repeat step e through step g to achieve a smooth crossover.

NOTE

If the frequency accuracy is out of specification in the following steps (i and j) it may be necessary to readjust A5R62 and A5R67 to achieve frequency accuracy throughout the wideband.

i. Set M1 to 200 MHz and check the frequency accuracy at sweeptimes .01 and .1 SEC.

j. Set M2 to 2 GHz and check the frequency accuracy at sweeptimes .01 and .1 SEC.

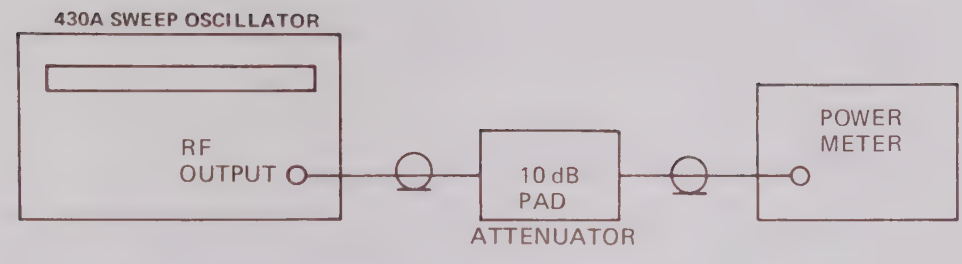


Figure 5-14. Wideband Leveled Power Variation, Test Setup

5.4.4.4 Wideband Leveled Power Variation

Proceed as follows:

a. Connect the equipment as shown in Figure 5-14.

b. Set the Model 430A controls as follows:

BAND SELECT	WB (wideband)
SWEEP FUNCTION	F1 - F2 (10 MHz– 2 GHz respectively)
SWEEP TIME	.1 SEC.

c. Turn the RF LEVEL control ccw until the UNLEVELED indicator goes out.

d. Set the SWEEP FUNCTION to CW-M1.

e. Vary M1 from 10 MHz to 2 GHz keeping the UNLEVELED indicator from illumination by decreasing the RF LEVEL as necessary.

f. Observe the power meter as M1 is again varied across the band.

g. Note the minimum and maximum points in decibels and milliwatts. The difference in dB is the wideband peak-to-peak leveled power variation. The minimum point in milliwatts is the wideband minimum leveled power.

h. The readings in step g must be within the specifications for the Model 438A RF unit.

5.5 CORRECTIVE MAINTENANCE

This section contains instructions for accessing and troubleshooting printed circuit assemblies, and includes Fault Isolation Diagrams to be utilized in troubleshooting casualties within the RF Units. Table 5-3 depicts applicable symbols used in the diagrams. Table 5-4 is included to document abbreviations unique to the diagrams. Abbreviations and designations of a more general nature are included in Tables 6-1A, B and C of this manual.

5.5.1 Printed Circuit Card Removal and Replacement

Access to all assemblies of the 430 Series RF Units is provided through the top cover of the chassis, via removal of the five cover screws. Assembly location is depicted in Figures 7-1, 7-4, 7-7 or 7-8 as applicable. All RF Units are provided with a hinged circuit board mounting assembly to which up to three assemblies may be mounted. On all units except the 438A and the 435A/4309A, the hinged assembly houses the A2 and A12 Assemblies. On the 438A, the A2 and A5 assemblies are so mounted. On the 435A/4309A, the hinged assembly contains the A2, A12 and A14 Assemblies. To allow the hinged assembly to swing upward 90° for access, press the release button at the rear of the unit and raise the assembly.

NOTE

The spring-loaded plunger at the front of the unit is removeable. Insure that the plunger is removed to prevent it from inadvertently falling into the unit circuitry and possibly damaging electronic components.

Raising the hinged assembly to the 90° position provides access to all of the remaining assemblies contained within the unit. Each assembly, with the exception of the A14 Assembly, may be completely removed from the unit by removing any Quick Disconnect connections and the hold-down screws. The A14 Assembly, in additon to a hold-down screw, is provided with two hold-down spring clamps which maintain the assembly in place between the A2 and A12 assemblies.

Replacement of any assembly is effected in the exact opposite sequence as removal.

NOTE

Before lowering the hinged assembly from the 90° position, insure that the spring and plunger at the front of the unit are in position to facilitate proper locking in the normal position.

5.5.2 Fault Isolation Procedures

The Fault Isolation Diagrams included in this section are designed for use in troubleshooting casualties in the RF Unit and, by reference, the Model 430 Mainframe. Notes relevant to each diagram are found on the page facing the diagram.

TABLE 5-3. DIAGRAM SYMBOLOGY

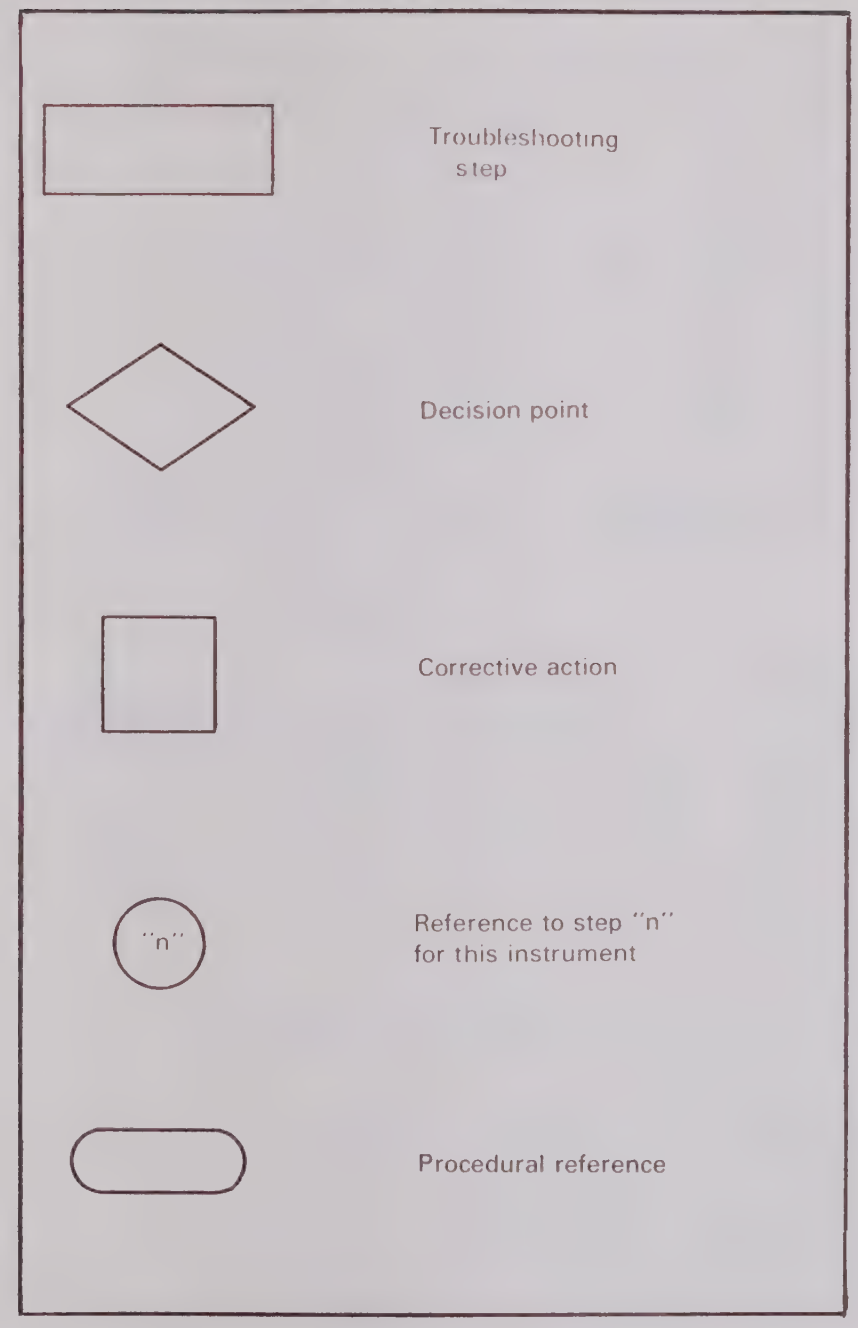


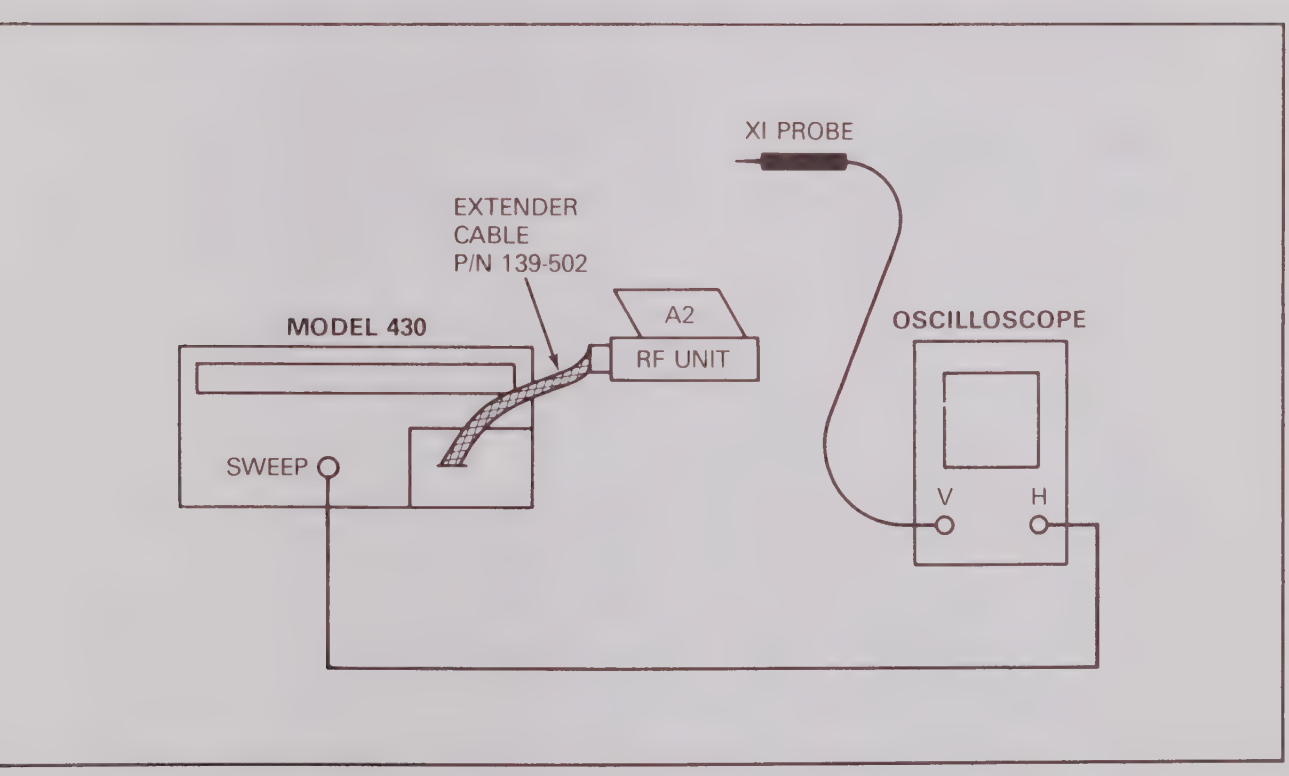
TABLE 5-4. DIAGRAM ABBREVIATIONS

Atten	Attenuation or Attenuator
Ckt	Circuit
Conn	Connector
Det	Detector
Dir	Directional
ITP	Intermediate Test Point
LED	Light Emitting Diode
Ref	Reference
Reg	Regulator or Regulated
T.V.	Tuning Voltage
Xtal	Crystal
Yig	Yig-tuned oscillator

Test Set-up #1

Model 430	Function Switch	"F1-F2"
	Trigger	"Auto"
	F1	"Nominal Low End"
	F2	"Nominal High End"
RF Unit	Xtal/Pwr Meter Switch	"Xtal"

Utilize extender cable and oscilloscope with a "times 1" probe as shown.



Test Set-up #2

Refer to Figure 5-2.

Figure 5-15. TEST CONFIGURATIONS

NOTES APPLICABLE TO FIGURE 5-16

1 Use Diagram #1 with Troubleshooting Simplified Schematic, Figure 7-36.

2. For continuation of Procedural Reference to RF Output Defect, refer to Diagram #3

3. Bias Voltage: +15 VDC for all Avantek YIG oscillators; W/E and WJ bias is stamped on component.

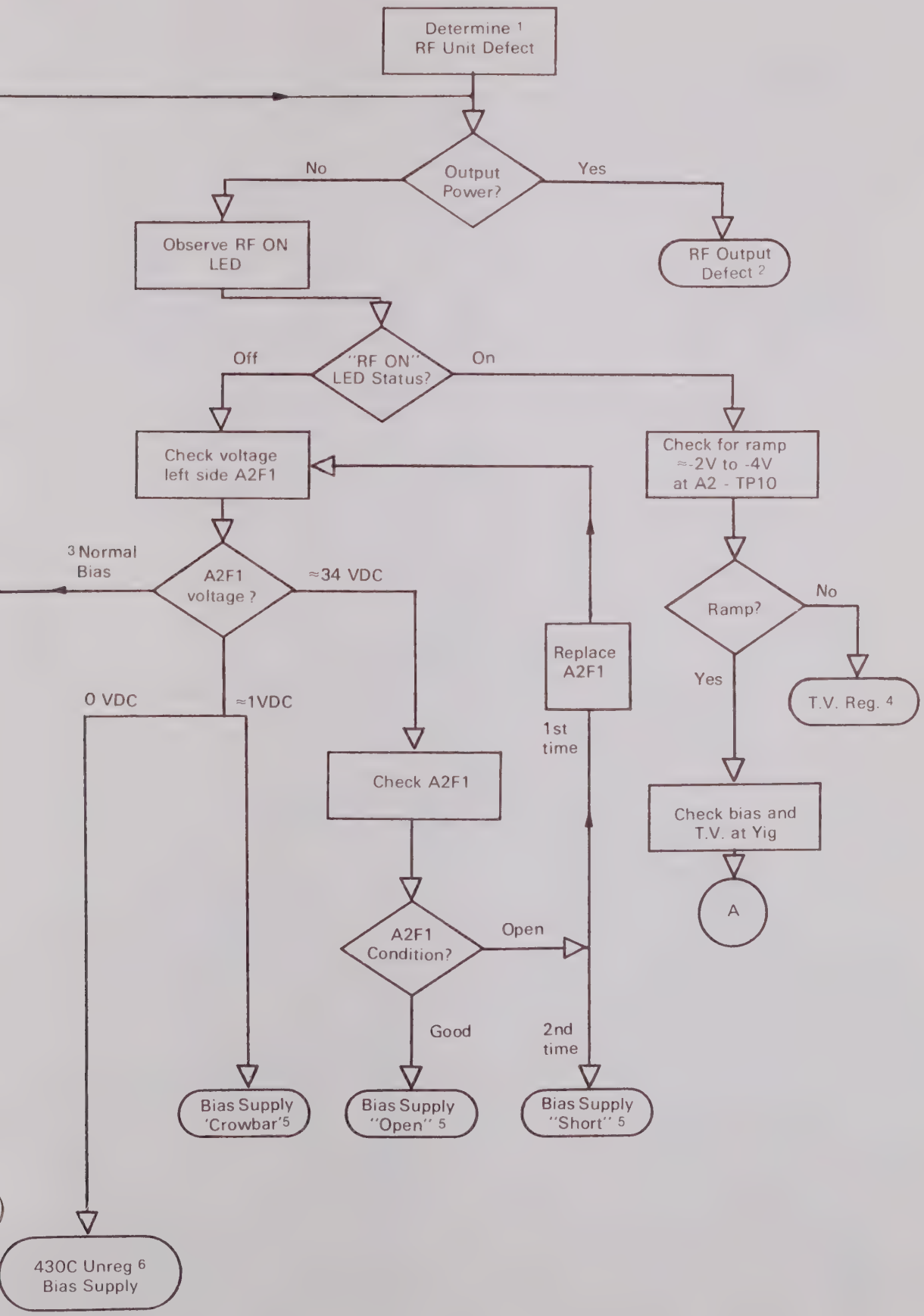
4. For continuation of Procedural Reference to T.V. Reg, refer to Diagram #3.

5. For continuation of Procedural Reference to Bias Supply "Crowbar", "Open" and "Short", refer to Diagram #7.

6. For continuation of Procedural Reference to 430C Unreg Bias Supply, refer to Model 430C Operation and Service Manual, Fault Isolation Procedures.

A. Refer to Diagram #2.

Figure 5-16. Fault Isolation Diagram #1

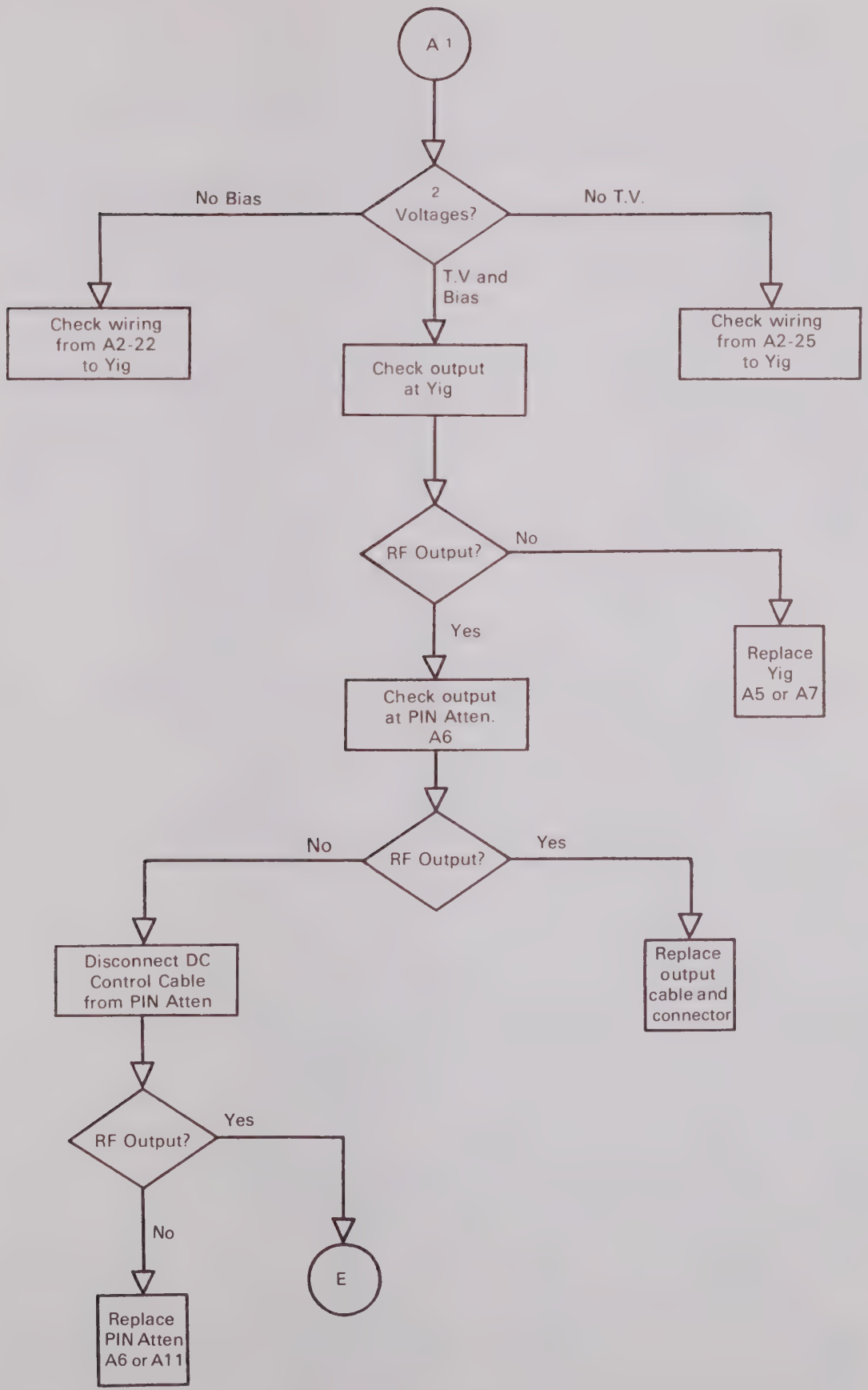


NOTES APPLICABLE TO FIGURE 5-17

1. Configure equipment according to Figure 5-15, Test Set-up #1.
2. Use Diagram 2 with Troubleshooting Simplified Schematic, Figure 7-37.

E. Refer to Diagram #6.

Figure 5-17. Fault Isolation Diagram #2



NOTES APPLICABLE TO FIGURE 5-18

1. DC Stability should be $< \pm$ 1mV with no measurable high frequency oscillation.

2. Configure equipment according to Figure 5-15, Test Set-up #1.

3. For continuation of Procedural Reference to 430C Bias Supply, refer to Model 430C Operation and Service Manual, Fault Isolation Procedures.

4. For continuation of Procedural Reference to Bias Supply, refer to Diagram #7.

B. Refer to Diagram #4.

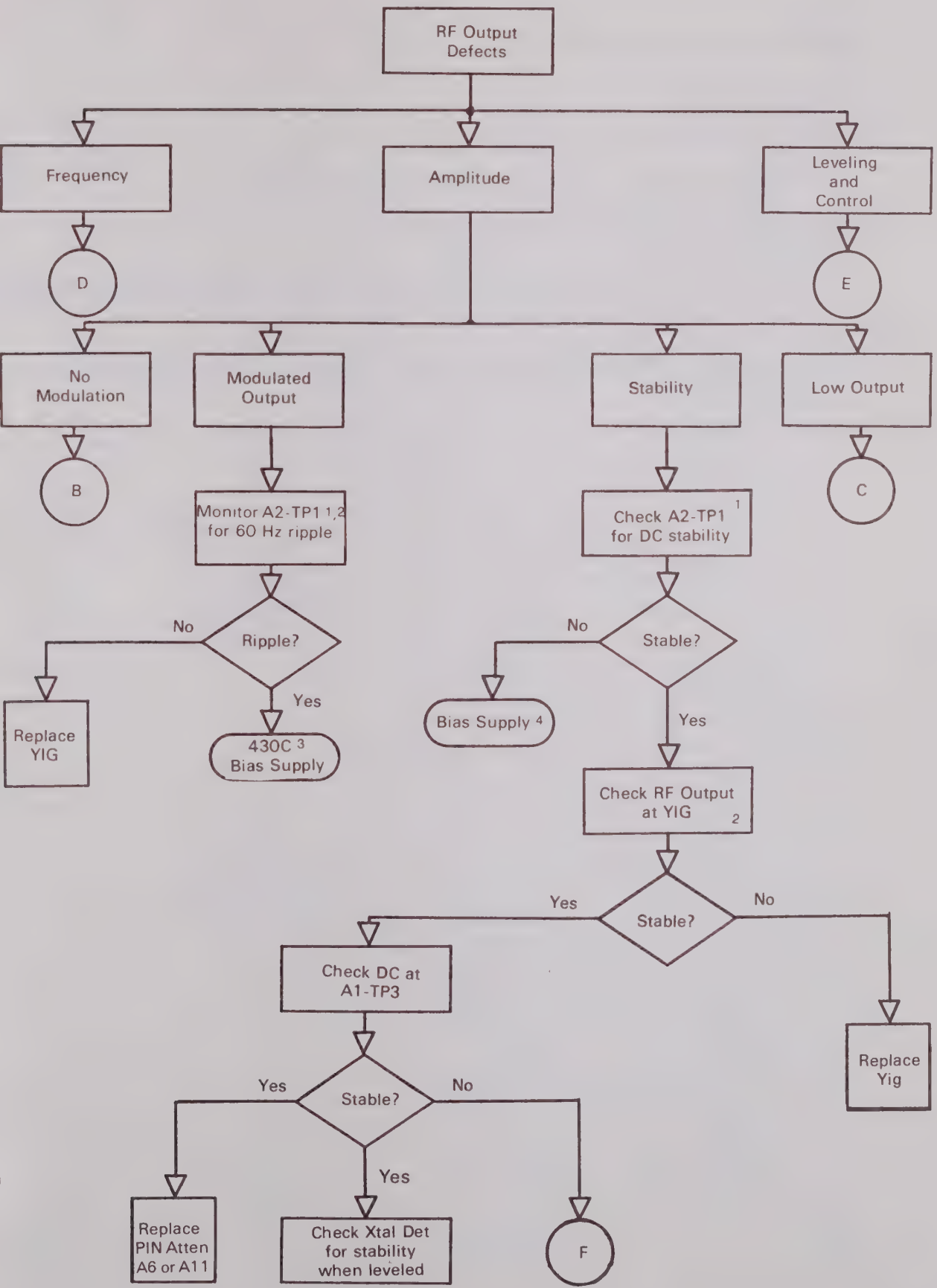
C. Refer to Diagram #4.

D. Refer to Diagram #5.

E. Refer to Diagram #6.

F. Refer to Diagram #8.

Figure 5-18. Fault Isolation Diagram #3



NOTES APPLICABLE TO FIGURE 5-19

1. Configure equipment according to Figure 5-15, Test Set-up #1.

2. Configure equipment according to Figure 5-15, Test Set-up #2.

3. Use Diagram #4 with Troubleshooting Simplified Schematic Figure 7-38.

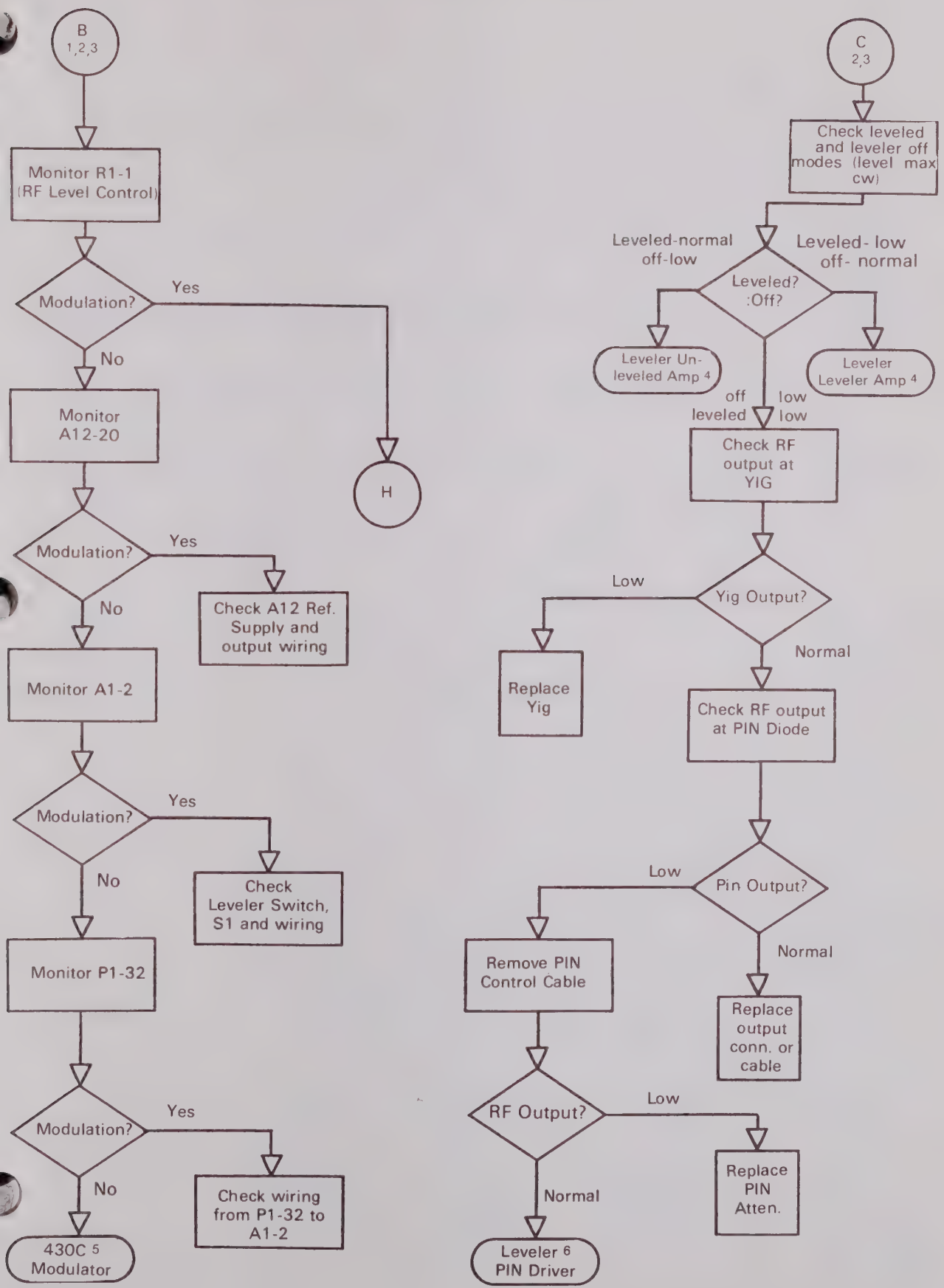
4. For continuation of Procedural Reference to Unleveled Amp and Leveler Amp refer to Figure 7-13 and Diagram #6.

5. For continuation of Procedural Reference to 430C Modulator, refer to Model 430C Operation and Service Manual, Fault Isolation Procedures.

6. For continuation of Procedual Reference to Leveler Pin Driver, refer to appropriate Overall Schematic Diagram.

H. Refer to Diagram #8.

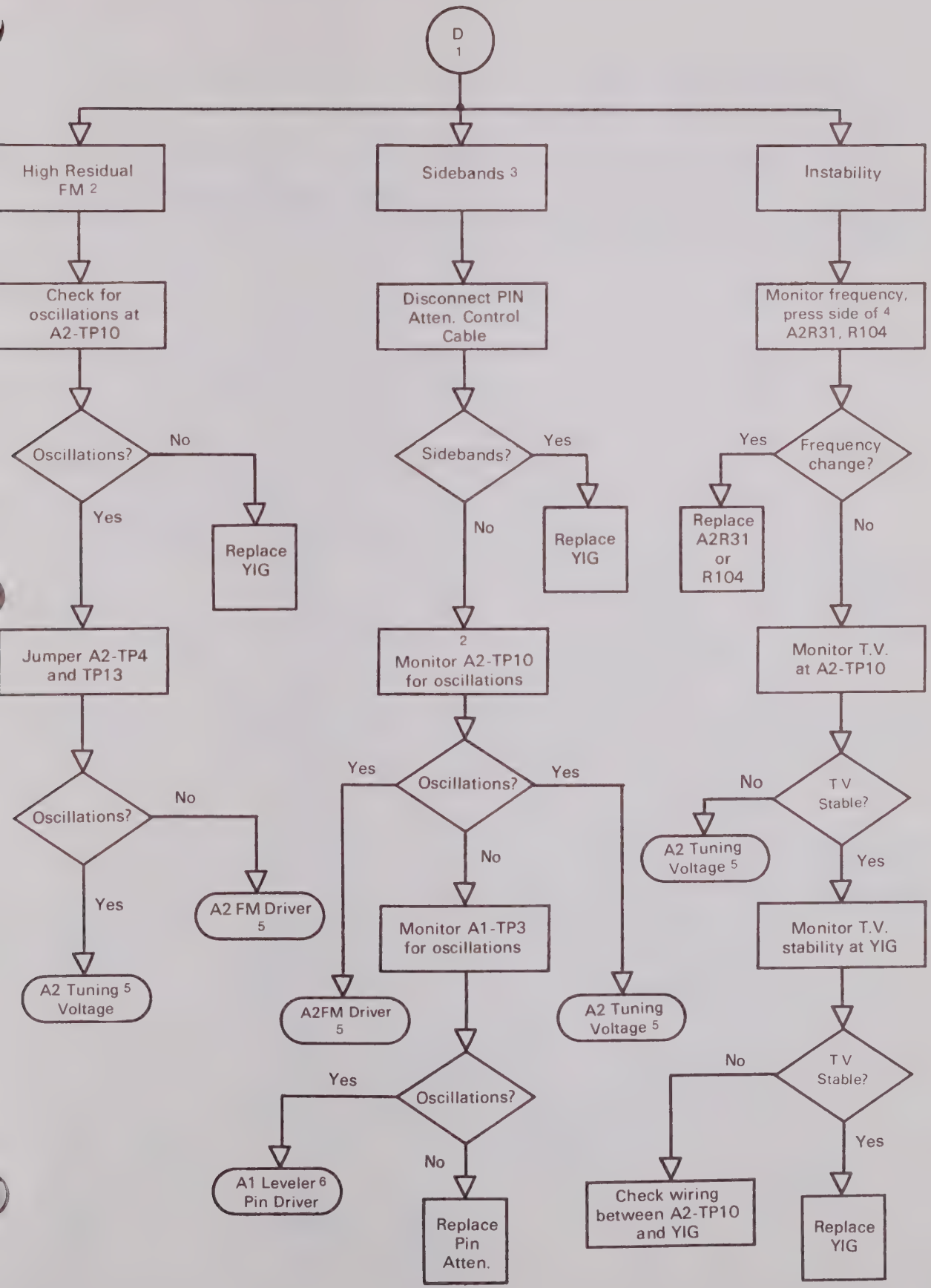
Figure 5-19. Fault Isolation Diagram #4



NOTES APPLICABLE TO FIGURE 5-20

1. Use Diagram #5 with Troubleshooting Simplified Schematics, Figures 7-36, 7-37 and 7-38.
2. Configure equipment according to Figure 5-15, Test Set-up #1.
3. Configure equipment according to Figure 5-15, Test Set-up #2.
4. Side pressure to either resistor may change frequency by ≈ 2 MHz, but release of pressure should cause return to original frequency.
5. For continuation of Procedual Reference to A2 FM Driver and A2 Tuning Voltage refer to Figure 7-36.
6. For continuation of Procedual Reference to A1 Leveler PIN Driver, refer to Figure 7-13.

Figure 5-20. Fault Isolation Diagram #5



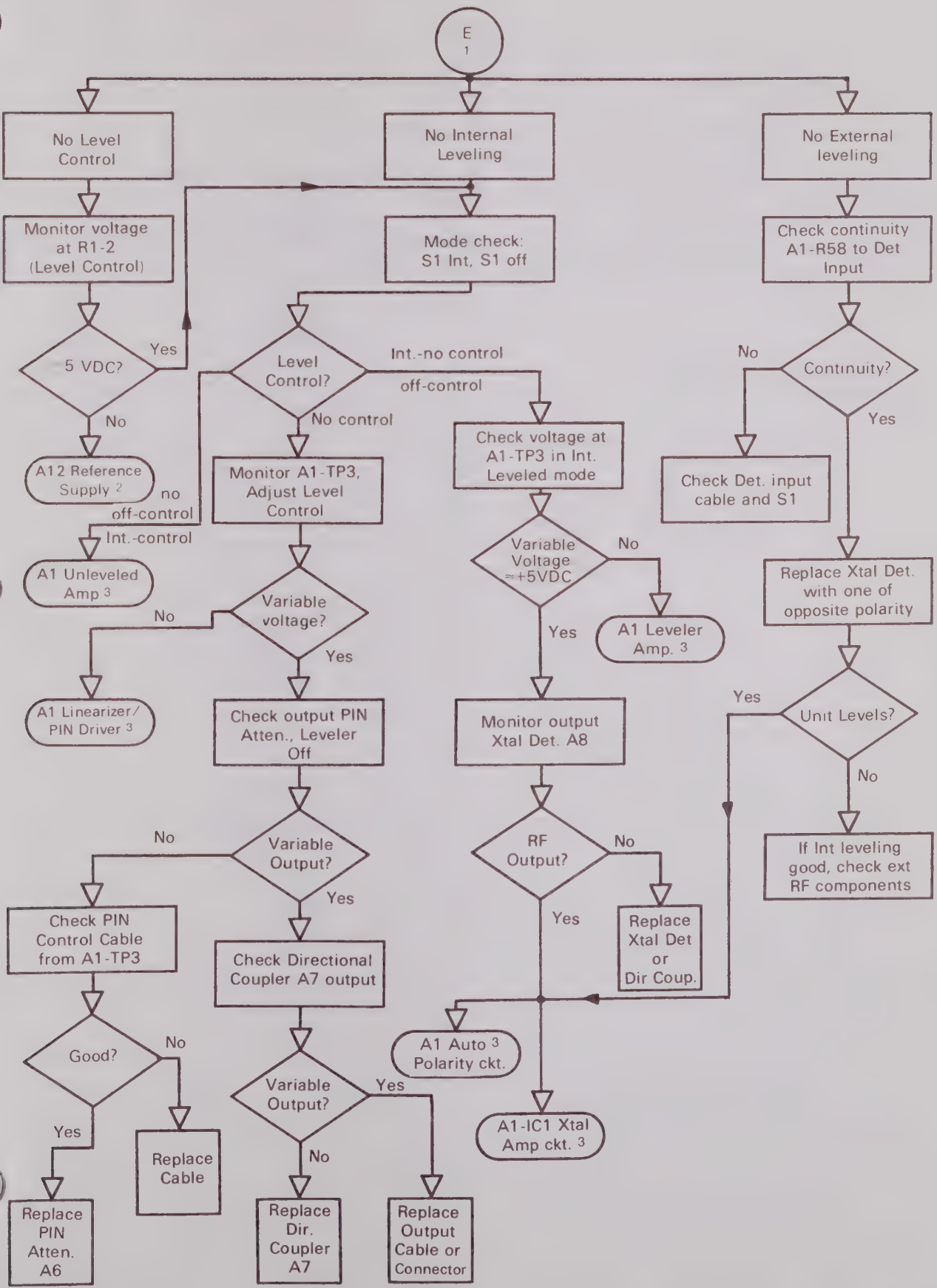
NOTES APPLICABLE TO FIGURE 5-21

1. Use Diagram #6 with Troubleshooting Simplified Schematic, Figure 7-38.

2. For continuation of Procedural Reference to A12 Reference Supply, refer to Figure 7-31.

3 For continuation of Procedural Reference to A1 Unleveled Amp, A1 Linearizer/PIN Driver, A1 Leveler Amp, A1 Autopolarity Ckt. or A1-IC1 Xtal Amp Ckt, refer to Figure 7-13.

Figure 5-21. Fault Isolation Diagram #6



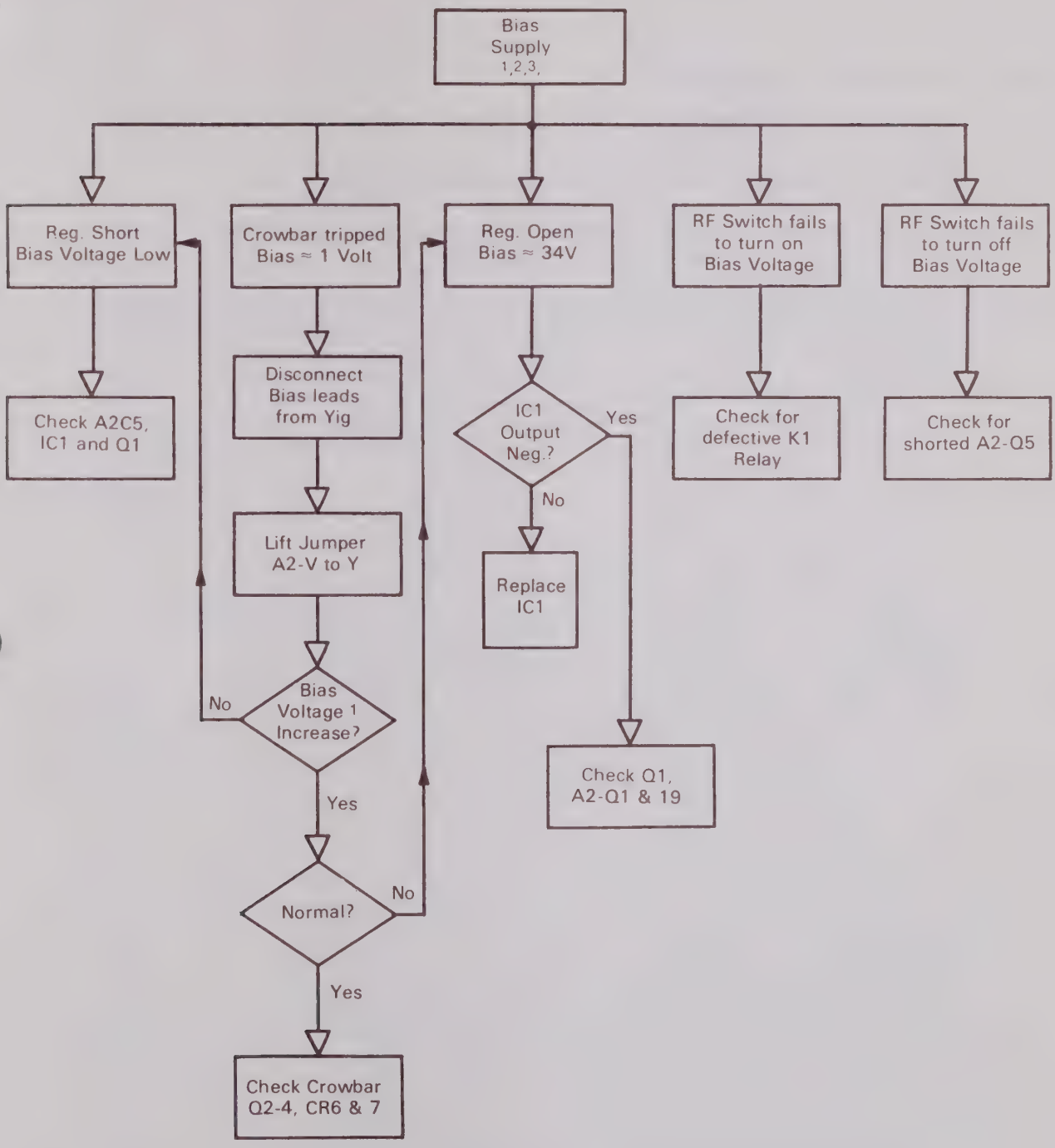
NOTES APPLICABLE TO FIGURE 5-22

1. Configure equipment according to Figure 5-15, Test Set-up #1.

2. Bias Voltage: +15 VDC for all Avantek Yig oscillators; W/E and WJ bias is stamped on component.

3. Use Diagram #7 with Troubleshooting Simplified Schematic, Figure 7-37.

Figure 5-22. Fault Isolation Diagram #7



NOTES APPLICABLE TO FIGURE 5-23

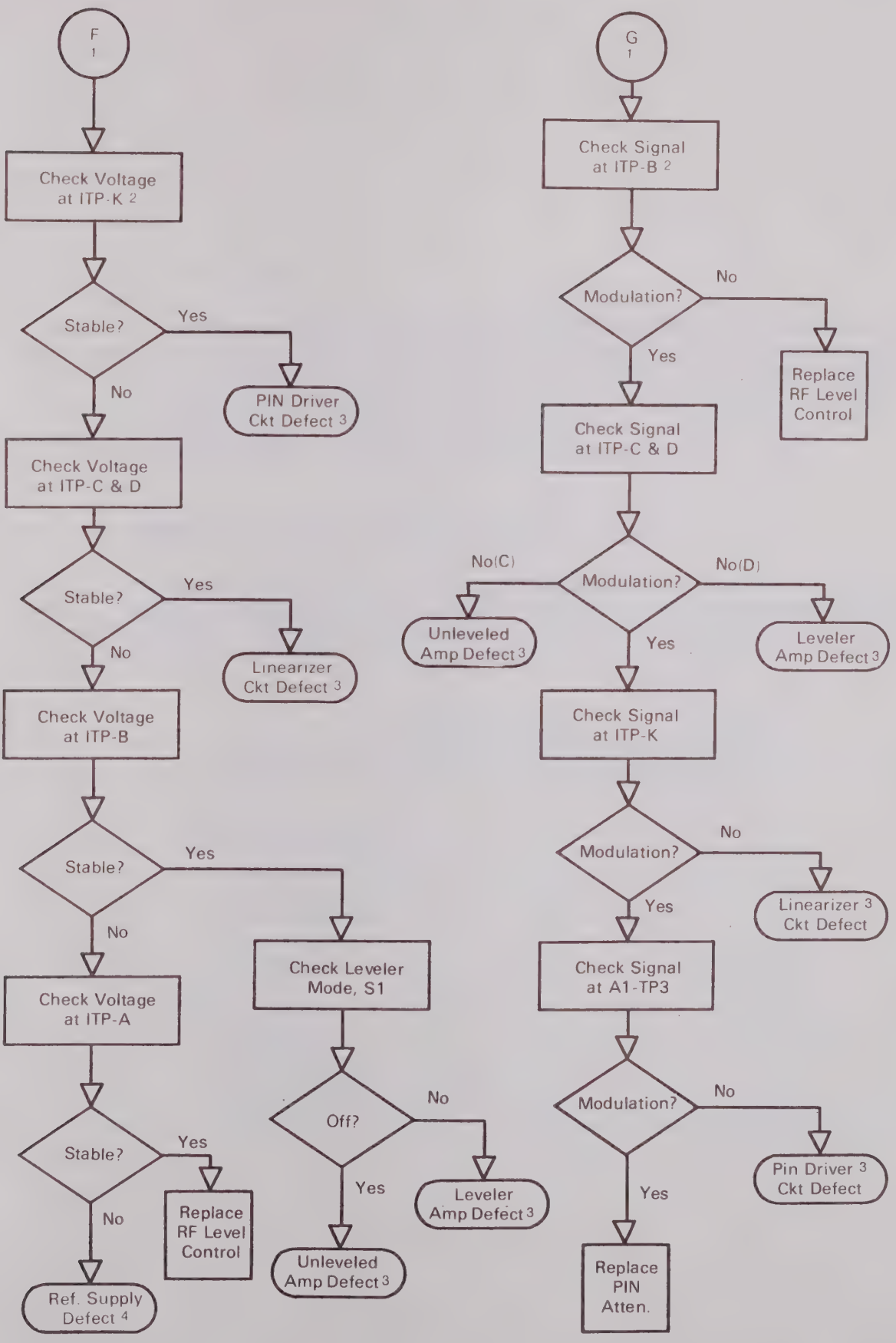
1 Use Diagram #8 with Troubleshooting Simplified Schematic, Figure 7-38.

2 ITP's (Intermediate Test Points) relate to circled letters denoted in Figure 7-38.

3 For continuation of Procedural Reference to Pin Driver Ckt Defect, Linearizer Ckt Defect, Leveler Amp Defect or Unleveled Amp Defect, refer to Figure 7-13.

4 For continuation of Procedural Reference to Ref Supply Defect, refer to Figure 7-31 (all Models except 438A) or Figure 7-26 (Model 438A only).

Figure 5-23. Fault Isolation Diagram #8



SECTION 6

REPLACEABLE PARTS

6.1 INTRODUCTION

This section provides information for procuring replaceable parts for the RF units. The parts listed include all parts subject to burnout, breakage or deterioration during normal operation of the equipment. Depending upon availability of parts, particularily for resistors and capacitors, parts may be used in combination (series, parallel, or both) to obtain the fixed value specified in parts list. Also, for "Select at Test" components, parts may be used in combination to obtain required test results, or in some cases no parts may be used.

6.2 REFERENCE DESIGNATIONS AND ABBREVIATIONS

All reference designations for electrical parts are preceded by a prefix which indicates the assembly in which the part is contained. Table 6-1A identifies the assembly designations used in all basic models except the Model 438A. Table 6-1B identifies the assembly designations used in the Model 438A only. Table 6-1C provides a list of all abbreviations used throughout these parts list.

TABLE 6-1A
ASSEMBLY DESIGNATIONS, ALL MODELS EXCEPT 438A

A1	–	Leveler
A2	–	Tuning and Bias Supplies
A3	–	Auxiliary Termination Board
A4	–	Symmetrical Sweep Switch
A5	–	Solid State Oscillator
A6	–	Pin Diode Switch
A7	–	Directional Coupler
A8	–	Crystal Detector
A9	–	Isolator
A10	–	Step Attenuator
A11	–	Heat Exchanger
A12	–	Auxiliary Board
A13	–	Linearity and Auxiliary Circuit Board
A14	–	Solid State Switch

TABLE 6-1B
ASSEMBLY DESIGNATIONS, MODEL 438A ONLY

A1	–	Leveler
A2	–	Tuning and Bias Supply
A3	–	Heater
A4	–	Symmetrical Sweep Switch
A5	–	Control Logic
A6	–	1-2 GHz Crystal Detector
A7	–	Solid State Oscillator
A8	–	Oscillator/Filter
A9	–	Amplifier
A10	–	1-2 GHz Directional Coupler
A11	–	Pin Diode Switch
A12	–	0.01-1 GHz Crystal Detector
A13	–	0.01-1 GHz Directional Coupler
A14	–	Step Attenuator
A15	–	Mixer

TABLE 6-1C
ABBREVIATIONS

A	–	Amperes	FWD	–	Forward	PC	–	Printed Circuit
AMPL	–	Amplifier	G	–	Giga = 10^9	pF	–	Pico farads = 10^{-12} farads
AM	–	Amplitude modulation	GRD	–	Ground			
APPROX	–	Approximate	H	–	Henry	P/O	–	Part of
ASS'Y	–	Assembly	Hz	–	Cycle per second	P-P	–	Peak to Peak
AUX	–	Auxiliary	IDENT	–	Identification	RECT	–	Rectifier
AVG	–	Average	IMP	–	Impulse	RES	–	Resistance or Resistor
BAL	–	Balance	INT	–	Internal	RET	–	Return
BWO	–	Backward wave oscillator	K	–	Kilo = 10^3	REV	–	Reverse
			LIN	–	Linear	RF	–	Radio Frequency
C	–	Cathode	M	–	Milli = 10^{-3}	RMS	–	Square root of mean square
CAL	–	Calibrator	MAX	–	Maximum			
ccw	–	Counterclockwise	MEG	–	Meg = 10^6	SEC	–	Second
cw	–	Clockwise	MFG	–	Manufacturer	SW	–	Switch
dB	–	Decibel	MIN	–	Minimum	SYM	–	Symmetrical
dBm	–	Decibel (referred to 1 milliwatt in 50 ohms)	N	–	Nano = 10^{-9}	TRIG	–	Trigger
			NC	–	Normally closed	TYP	–	Typical
EXT	–	External	NEG	–	Negative	u	–	Micro = 10^{-6}
F	–	Farad	NO	–	Normally open	V	–	Volt
FIG	–	Figure	Ω	–	Ohm	VAR	–	Variable
FIX	–	Fixed	O	–	Peak	W	–	Watts
FM	–	Frequency Modulate	J	–	Jack	R	–	Resistor
A	–	Assembly	K	–	Relay	S	–	Switch
B	–	Motor	L	–	Inductor	T	–	Transformer
C	–	Capacitor	M	–	Meter	TB	–	Terminal Board
CR	–	Diode	P	–	Plug	V	–	Vacuum
DS	–	Lamp	Q	–	Transistor	X	–	Socket
F	–	Fuse						

6.3 PARTS LISTS AND CROSS REFERENCE TABLE

Table 6-2 is a model/assembly cross reference Table which lists assembly applicability to each of the RF Unit model. This table provides the part number of each major assembly. Table 6-2-1 reflects the revision level applicable to each board located within the RF Units; Table 6-2-2 is a special parts lists for basic chassis parts.

6.4 ORDERING INFORMATION

The following information should be included when ordering replacement parts for the RF Units.

a. Weinschel Engineering Part Number and Description of Part.

b. The instruments Model Number and Serial Number.

c. If ordering a part not included in the replaceable parts list, include a complete description of the part, its function and its location within the equipment.

d. All IN914 diodes are replaced by IN3064 diodes; IN914 and IN3064 diodes are interchange cable.

6.5 MANUFACTURER CODES

The manufacturer codes are identified by manufacturer in Appendix A of this manual.

TABLE 6-2. ASSEMBLY APPLICABILITY BY PART NUMBER (See Table 6-3 for applicable table. Order from this list if no table is referenced).

MODEL	FREQ RANGE	SCALE PART NUMBER	LEVELER A1	TUNING AND BIAS SUPPLY A2	AUX TERM BD A3	SYMMETRICAL SWEEP SWITCH A4	SOLID STATE OSCILLATOR A5 (2)	PIN DIODE SWITCH A6	DIRECTIONAL COUPLER A7(4)	CRYSTAL DETECTOR A8	ISOLATOR A9	STEP ATTENUATOR A10	HEAT EXCHANGER A11	AUXILIARY BOARD A12	TERMINAL BOARD A13 (UNITS WITH SERIAL NO. BELOW 1994)	LINEARITY AND AUX CIRCUIT BD A13 (UNITS WITH SERIAL NO. 1994 & UP)	SOLID STATE SWITCH A14(5)
431A-1	1.0-2.0	B139-323	C139-168-2	C139-109-20	B139-814	B139-199	16-95	B1-102	B250-313	B139-624		-----		C139-559			
431AB	1.0-2.0	B139-323	C139-168-2	C139-109-20	B139-814	B139-199	16-95	B1-102	B250-313	B139-624		C89-909-1		C139-559			
431AP-1	1.0-2.0	B139-323	C139-168-2	C139-109-20	B139-814	B139-199	16-95-1	B1-102	B250-313	B139-624		-----		C139-559			
431APB	1.0-2.0	B139-323	C139-168-2	C139-109-20	B139-814	B139-199	16-95-1	B1-102	B250-313	B139-624		C89-909-1		C139-559			
432A	2.0-4.0	B139-270	C139-168-2	C139-109-21	B139-814	B139-200	16-92	B1-167	-----	-----	B1-83	-----		C139-559			
432A-1	2 0-4.0	B139-270	C139-168-2	C139-109-21	B139-814	B139-200	16-92	B1-167	B250-332	C89-928-1	B1-83	-----		C139-559			
432AB	2.0-4.0	B139-270	C139-168-2	C139-109-21	B139-814	B139-200	16-92	B1-167	B250-332	C89-928-1	B1-83	C89-909-2		C139-559			
432A-2	2.0-4.0	B139-270	-----	C139-109-21	B139-814	B139-200	16-92	-----	-----	-----	B1-83	-----		C139-559			
432AP	2.0-4.0	B139-270	C139-168-2	C139-109-21	B139-814	B139-200	16-99	B1-167	-----	-----	B1-83	-----		C139-559			
432AP-1	2.0-4.0	B139-270	C139-168-2	C139-109-21	B139-814	B139-200	16-99	B1-167	B250-332	C89-928-1	B1-83	-----		C139-559			
432APB	2.0-4.0	B139-270	C139-168-2	C139-109-21	B139-814	B139-200	16-99	B1-167	B250-332	C89-928-1	B1-83	C89-909-2		C139-559			
432AP-2	2.0-4.0	B139-270	-----	C139-109-21	B139-814	B139-200	16-99	-----	-----	-----	B1-83	-----		C139-559			
433AH	4.0-8 0	B139-272	C139-168-2	C139-109-15	B139-814	B139-788	16-144-1	B1-167	-----	-----	B1-87	-----		C139-559			
433AH-1	4.0-8.0	B139-272	C139-168-2	C139-109-15	B139-814	B139-788	16-144-1	B1-167	B250-330-1	C89-928-1	B1-87	-----		C139-559			
433AHB	4.0-8.0	B139-272	C139-168-2	C139-109-15	B139-814	B139-788	16-90-1	B1-167	B250-330-1	C89-928-1	B1-87	C89-909-4		C139-559			
433AH-2	4.0-8.0	B139-272	-----	C139-109-15	B139-814	B139-788	16-144-1	-----	-----	-----	B1-87	-----		C139-559			
433AP	4.0-8.0	B139-272	C139-168-2	C139-109-15	B139-814	B139-788	16-144-1	B1-167	-----	-----	B1-87	-----		C139-559			
433AP-1	4.0-8.0	B139-272	C139-168-2	C139-109-15	B139-814	B139-788	16-144-1	B1-167	B250-330-1	C89-928-1	B1-87	-----		C139-559			
433APB	4.0-8.0	B139-272	C139-168-2	C139-109-15	B139-814	B139-788	16-109	B1-167	B250-330-1	C89-928-1	B1-87	C89-909-4		C139-559			
433AP-2	4.0-8.0	B139-272	-----	C139-109-15	B139-814	B139-788	16-144-1	-----	-----	-----	B1-87	-----		C139-559			
434AH	8.0-12.4	B139-273	C139-168-2	C139-109-23	B139-814	B139-789	16-114	B1-167	-----	-----	B1-75	-----	B139-316-1	C139-559			
434AH-1	8.0-12.4	B139-273	C139-168-2	C139-109-23	B139-814	B139-789	16-114	B1-167	B250-330-1	C89-928-1	B1-75	-----	B139-316-1	C139-559			
434AHB	8.0-12.4	B139-273	C139-168-2	C139-109-23	B139-814	B139-789	16-114	B1-167	B250-330-1	C89-928-1	B1-75	C89-909-5	B139-316-1	C139-559			
434AH-2	8.0-12.4	B139-273	-----	C139-109-23	B139-814	B139-789	16-111	-----	-----	-----	B1-75	-----	B139-316-1	C139-559			
434AP	8.0-12.4	B139-273	C139-168-2	C139-109-23	B139-814	B139-789	16-113	B1-167	-----	-----	B1-75	-----	B139-316-1	C139-559			
434AP-1	8.0-12.4	B139-273	C139-168-2	C139-109-23	B139-814	B139-789	16-113	B1-167	B250-330-1	C89-928-1	B1-75	-----	B139-316-1	C139-559			
434APB	8.0-12.4	B139-273	C139-168-2	C139-109-23	B139-814	B139-789	16-113	B1-167	B250-330-1	C89-928-1	B1-75	C89-909-5	B139-316-1	C139-559			
434AP-2	8.0-12.4	B139-273	-----	C139-109-23	B139-814	B139-789	16-113	-----	-----	-----	B1-75	-----	B139-316-1	C139-559			
435AH	12.4-18.0	B139-274	C139-168-2	C139-109-12	B139-814	B139-202	16-67	B1-98	-----	-----	B1-76	-----	B139-316-2	C139-559			
435AH-1	12.4-18 0	B139-274	C139-168-2	C139-109-12	B139-814	B139-202	16-67	B1-98	B250-330-1	C89-928-1	B1-76	-----	B139-316-2	C139-559			
435AHB	12 4-18.0	B139-274	C139-168-2	C139-109-12	B139-814	B139-202	16-67	B1-98	B250-330-1	C89-928-1	B1-76	C89-909-6	B139-316-2	C139-559			
435AH/ 4309A	12 4-18.0	B139-274	-----	C139-109-27	B139-814	B139-202	16-70[3]	-----	-----	-----	B1-76	-----	B139-316-2	C139-559	B139-372	B139-1032	C139-10
435AP	12.4-18.0	B139-274	C139-168-2	C139-109-12	B139-814	B139-202	16-81	B1-98	-----	-----	B1-76	-----	B139-316-2	C139-559			
435AP-1	12 4-18 0	B139-274	C139-168-2	C139-109-12	B139-814	B139-202	16-81	B1-98	B250-330-1	C89-928-1	B1-76	-----	B139-316-2	C139-559			
435APB	12.4-18.0	B139-274	C139-168-2	C139-109-12	B139-814	B139-202	16-81	B1-98	B250-330-1	C89-928-1	B1-76	C89-909-6	B139-316-2	C139-559			
435AP/4309A	12 4-18.0	B139-274	-----	C139-109-27	B139-814	B139-202	16-98[3]	-----	-----	-----	B1-76	-----	B139-316-2	C139-559	B139-372	B139-1032	C139-10
436A	18 0-26.5	B139-610	C139-168-2	C139-109-28	B139-814	B139-1080	16-106	B1-110	-----	-----	1-109	-----	B139-316-2	C139-559			
442A	1.7-4.2	B139-271	C139-168-2	C139-109-29	B139-814	B139-275	16-91	B1-72	-----	-----	B1-83	-----		C139-559			
442A-1	1 7-4 2	B139-271	C139-168-2	C139-109-29	B139-814	B139-275	16-91	B1-72	B250-330-1	C89-928-1	B1-83	-----		C139-559			
442AB	1 7-4 2	B139-271	C139-168-2	C139-109-29	B139-814	B139-275	16-91	B1-72	B250-330-1	C89-928-1	B1-83	C89-909-2		C139-559			
444A	10-15	B139-613	C139-168-2	C139-109-26	B139-814	SK2609	16-108	B1-98	-----	-----	B1-105	-----	B139-316-1	C139-559			
444A-1	10-15	B139-613	C139-168-2	C139-109-26	B139-814	SK2609	16-108	B1-98	B250-330-1	C89-928-1	B1-105	-----	B139-316-1	C139-559			
444AB	10-15	B139-613	C139-168-2	C139-109-26	B139-814	SK2609	16-108	B1-98	B250-330-1	C89-928-1	B1-105	C89-909-6	B139-316-1	C139-559			

NOTES:

1. Old Style A3 Board: B139-111.
2. Diode mounted on the Solid State Oscillator (A5 or A7 Assy.) is supplied by the manufacturer as part of the Solid State Oscillator.
3. Physically located in Model 4310 A/K Multiband Control Unit.
4. 50Ω terminations are included as part of the A7, A10, and A13 Directional Couplers. Weinschel Part Number B100-584.
5. Formally A12 Assy.

MODEL	FREQ RANGE	SCALE PART NUMBER	LEVELER A1	TUNING AND BIAS SUPPLY A2	HEATER A3	SYMMETRICAL SWEEP SWITCH A4	CONTROL LOGIC A5	CRYSTAL DETECTOR A6	SOLID STATE OSCILLATOR A7(2)	OSCILLATOR/ FILTER A8	AMPLIFIER A9	DIRECTIONAL COUPLER A10(4)	PINDIODE SWITCH A11	CRYSTAL DETECTOR A12	DIRECTIONAL COUPLER A13(4)	STEP ATTENUATOR A14	MIXER A15
438A-1	0 01-2 0	B139-388	C139-168-1	C139-109-19	A139-476-1	B139-199	139-459	B139-624	B16-95-1	B139-482-1	B16-96-1	B250-313	B1-102	B139-624	B250-314	-----	B139-643
438AB	0 01-2 0	B139-388	C139-168-1	C139-109-19	A139-476-1	B139-199	139-459	B139-624	B16-95-1	B139-482-1	B16-96-1	B150-313	B1-102	B139-624	B250-314	C89-909-7	B139-643
438AP-1	0 01-2 0	B139-388	C139-168-1	C139-109-19	A139-476-1	B139-199	139-459	B139-624	B16-95-1	B139-482-1	B16-96-1	B250-313	B1-1-2	B139-624	B250-314	-----	139-643
438APB	0 01-2 0	B139-388	C139-168-1	C139-109-19	A139-476-1	B139-199	139-459	B139-624	B16-95-1	B139-482-1	B16-96-1	B250-313	B1-102	B139-624	B250-314	C89-909-7	B139-643

TABLE 6-2-1. RF UNITS BOARD REVISION TABLE

MODEL	FREQ RANGE	LEVELER A1	TUNING AND BIAS SUPPLY A2	AUX REF SUPPLY A3	CONTROL LOGIC A5	HEAT EXCHANGER A11	AUXILIARY BOARD A12	SOLID STATE SWITCH A14
430A	Dependent on RF Unit							
438A	0.01-2.0				E			
431A	1.0-2.0							
442A	1.7-4.2		F,G					
432A	2.0-4.0		F,G,H					
433A	4.0-8.0		F,G,H				C,D	
434A	8.0-12.4		F,G,H				C,D,F	
444A	10.0-15.0							
435A	12.4-18.0		F,G,H					
436A	18.0-26.5							

TABLE 6-2-2
SPECIAL PARTS LIST OF R5, R6, AND R7 FOR BASIC CHASSIS (SEE TABLE 6-4A AND 6-4B)

MODEL	R5		R6		R7	
	Part No.	Desc.	Part No.	Desc.	Part No.	Desc.
431A	26-90-34R8	34.8Ω, 10W	26-8-15	**15Ω, 25W**	–	–
431AP	26-90-34R8	34.8Ω, 10W	26-90-33R2	**33.2Ω,10W**	–	–
432A	26-90-34R8	34.8Ω, 10W	26-90-33R2	33.2Ω, 10W	–	–
432AP	26-90-34R8	34.8Ω, 10W	26-90-33R2	33.2Ω, 10W	–	–
433AH	26-91-11	11Ω, 25W	26-90-33R2	33.2Ω, 10W	–	–
433AP	26-91-11	11Ω, 25W	26-90-33R2	33.2Ω, 10W	–	–
434AH	26-91-9.76	9.76Ω, 25W	26-90-33R2	33.2Ω, 10W	26-8-8	8Ω, 25W
434AP	26-91-9.76	9.76Ω, 25W	26-90-33R2	33.2Ω, 10W	26-8-8	8Ω, 25W
435AH	26-92-6R8	6.8Ω, 50W	26-8-8	8Ω, 25W	26-8-6	6Ω, 25W
435AP	26-92-6R8	6.8Ω, 50W	26-8-8	8Ω, 25W	26-8-6	6Ω, 25W
435A/ 4309A	26-92-7R5	7.5Ω, 1%, 50W	26-8-8	8Ω, 25W	Not used	–
436A	26-92-6R8	6.8Ω, 50W	26-8-8	8Ω, 25W	26-8-6	3Ω, 25W
438A-1	26-90-34R8	34.8Ω, 10W	26-8-15	15Ω, 25W	–	–

*In some units R6 is 15Ω, 5%, 25W.

TABLE 6-3. LIST OF ASSEMBLIES BY TABLE AND FIGURE NUMBER

Assembly	Table	Figure
Basic Chassis Assembly Parts List, all Models except 438A	6-4A	7-1, 7-7 or 7-8
Basic Chassis Assembly Parts List, Model 438A Only	6-4B	7-4
Assembly A1, Leveler Board (C139-168-2)	6-5A	7-11
Assembly A1, Leveler Board (C139-168-1), Model 438A	6-5B	7-11
Assembly A2, Tuning and Bias Supply Master Parts List	6-6	7-14, 7-15 or 7-16
Assembly A2, Tuning and Bias Supply (C139-109-20) Model 431A Series	6-6A	7-14, 7-15 or 7-16
Assembly A2, Tuning and Bias Supply (C139-109-21) Model 432A Series	6-6B	7-14, 7-15 or 7-16
Assembly A2, Tuning and Bias Supply (C139-109-15) Model 433A Series	6-6C	7-14, 7-15 or 7-16
Assembly A2, Tuning and Bias Supply (C139-109-23) Model 434A Series	6-6D	7-14, 7-15 or 7-16
Assembly A2, Tuning and Bias Supply (C139-109-12) Model 435A and 435A/4309A	6-6E	7-14, 7-15 or 7-16
Assembly A2, Tuning and Bias Supply (C-139-109-28) Model 436A	6-6F	7-14, 7-15 or 7-16
Assembly A2, Tuning and Bias Supply (C139-109-19) Model 438-1 Series	6-6G	7-14, 7-15 or 7-16
Assembly A2, Tuning and Bias Supply (D139-109-21) Model 441A, Parts List	6-6H	7-14, 7-15 or 7-16
Assembly A2, Tuning and Bias Supply (D139-109-26) Model 444A	6-6I	7-14, 7-15 or 7-16
Assembly A3, Aux Termination Bd (B139-814) Parts List, All Models Except 438A, 435A/4309A	6-7	7-21
Assembly A3, Heater Board (C139-476-1) Model 438A Only	6-8	7-23
Assembly A4, Symmetrical Sweep Switch (B139-199, Model 431A, 431AP, 438A, 438AP	6-9	7-24
Assembly A4, Symmetrical Sweep Switch (B139-200, Model 432A	6-10	7-24
Assembly A4, Symmetrical Sweep Switch (B139-788, Model 433A	6-11	7-24
Assembly A4, Symmetrical Sweep Switch (B139-789, Model 434A	6-12	7-24
Assembly A4, Symmetrical Sweep Switch (B139-202, Model 435A	6-13	7-24
Assembly A4, Symmetrical Sweep Switch (SK3265, Model 436A	6-14	7-24
Assembly A4, Symmetrical Sweep Switch (B139-275, Model 442A	6-15	7-24
Assembly A4, Symmetrical Switch (SK2609 Model 444A	6-16	7-24
Assembly A5, Control Logic (C139-459) Parts List, Model 438A	6-17	7-25
Assembly A8, Fixed Oscillator Filter Assy., Model 438A	6-18	7-27
Assembly A11, Heat Exchanger (139-316-1) Models 434A, 436A, 444A	6-19	7-29
Assembly A11, Heat Exchanger (139-316-2) Models 435A, 435A, 4309A	6-20	7-29
Assembly A12, Auxiliary Board (C139-559), All Models Except 438A	6-21	7-30
Assembly A13, Linearity and Auxiliary Circuit Board Assembly (B139-1032) Model 435A/4309A, Serial No. 1994 and up	6-22	7-32
Assembly A14, Solid State Switch Assembly (C139-10), Model 435A/4309A	6-23	7-34
RF Cable and Connector Parts List	6-24	7-5

6.6 ASSEMBLY, FIGURE AND TABLE REFERENCE

Table 6-3 provides a cross-reference between each assembly by name and number, and the applicable component identification drawing number and the parts list table number. Parts listings for all major RF Unit Assemblies are contained in Tables 6-4A through 6-24.

TABLE 6-4A. BASIC CHASSIS ASSEMBLY PARTS LIST, ALL MODELS EXCEPT 438A

REF. DES.	WEINSCHEL PART NO.	DESCRIPTION	MFG. PART NO.	MFG. CODE
A1*		See Table 6-2		93459
A2		See Table 6-2		93459
A3		See Table 6-2		93459
A4		See Table 6-2		93459
A5		See Table 6-2		93459
A6*		See Table 6-2		93459
A7*		See Table 6-2		93459
A8*		See Table 6-2		93459
A9		See Table 6-2		93459
A10*		See Table 6-2		93459
A11		See Table 6-2		93459
A12		See Table 6-2		93459
A13		See Table 6-2		93459
A14		See Table 6-2		93459
AT1	3T[3]	Fixed Attenuator, SAT		93459
CR1		Not Used		
CR2		Not Used		
DS1	12-191	Lamp Indicator	5082-4403	50434
DS2*	12-191	Lamp Indicator	5082-4403	50434
J1	62-76[4]	Connector, Receptacle	26-221	13511
J2*	63-5	Connector, Jack BNC	UG1094/U	
J3	63-5	Connector, Jack BNC	UG1094/U	
J4*	63-5	Connector, Jack BNC	UG1094/U	
J5*	63-5-1	Connector, Jack BNC	4760-3	77820
P1	62-161	Connector, Plug 36 Pin	57-10360	13511
Q1	12-177	Transistor PNP	MJ900	04713
Q2	12-178	Transistor NPN	MJ1000	04713
R1/R2*[1]	20-201	Res, Vari, 1K concentric, 10%, 1/2W	70B4N048P102W	01121
R3		Res, 100 ohms, 10%, 1/2W		
R4*	20-193-1000	Res, Vari, 1K, 10%, 1/2W	YN102U	50139
R5		See Table 6-2-1		
R6		See Table 6-2-1		
R7		See Table 6-2-1		
S1	55-51	Switch, Toggle, SPDT	7101-PYP2BE	09353
	1-118-1	Low Pass Filter (Model 431A)		
	1-118-2	Low Pass Filter (Model 432A)		
	1-118-3	Low Pass Filter (Model 433A)		
	1-118-5	Low Pass Filter (Model 434A)		
	1-118-7	Low Pass Filter (Model 435A)		
C1[2]	31-80	Cap, Tant, 10µF, 35V	T362C106M035AS	31433
C2[2]	31-80	Cap, Tant, 10µF, 35V	T362C106M035AS	31433

* Not used in -2 RF unit.

[1] Not used in B option.

[2] Used only in Model 435A/4309A, mounted on A13.

[3] Used in Models 432A and 432AP-2.

[4] Not used on Models 432A-2, 432AP-2, 433AH-2, 433AP-2, and 434A-2.

TABLE 6-4B. BASIC CHASSIS ASSEMBLY PARTS LIST, MODEL 438A ONLY

REFERENCE DESIGNATION	¥ PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1		See Table 6-2		
A2		See Table 6-2		
A3		See Table 6-2		
A4		See Table 6-2		
A5		See Table 6-2		
A6		See Table 6-2		
A7		See Table 6-2		
A8		See Table 6-2		
A9		See Table 6-2		
A10		See Table 6-2		
A11		See Table 6-2		
A12		See Table 6-2		
A13		See Table 6-2		
A14		See Table 6-2		
A15		See Table 6-2		
C1	34-28-104	Capicator, .1 μF, 10% 100V	81349	CK05BX104K
DS1	12-191	Lamp, indicator	50434	5082-4403
DS2	12-191	Lamp, indicator	50434	5082-4403
DS3	12-191	Lamp, indicator	50434	5082-4403
DS4	12-191	Lamp, indicator	50434	5082-4403
J1	62-76	Connector, Receptacle	13511	26-221
J2	63-5	Connector, Jack		UG1094/U
J3	63-5	Connector, Jack		UG1094/U
J4		Not Used		
J5	63-5-1	Connector, Jack	77820	4760-3
P1	62-161	Connector, plug 36 pin	13511	57-10360
Q1	12-177	Transistor, PNP	04713	MJ900
Q2	12-178	Transistor, NPN	04713	MJ1000
R1/R2	20-201	Resistor, variable, concentric, 1K, 10%, ½W	01121	70B4N048P102W
R3		Resistor, 100 ohm, 10%, ½W		
R4	20-193-1000	Resistor, variable 1K, 10%, ½W		
R5		See Table 6-2-1	50139	YN102U
R6		See Table 6-2-1		
S1	55-51	Switch, toggle SPDT	09353	7101-PYP2BE

TABLE 6-5A. ASSEMBLY A1, LEVELER BOARD (C139-168-2) (ALL UNITS EXCEPT 438A)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		Refer to Table 6-5B for a listing of components unique to the 438A A1 board.		
C1	34-27-560	Cap 56pF 10% 200V	81349	CK05BX560K
C2	34-28-104	Cap .1μF 10% 100V	81349	CK06BX104K
C3		Select at test		
C4	34-28-104	Cap .1μF 10% 100V	81349	CK06BX104K
C5	34-28-222	Cap 2200pF, 10%, 200V	81349	CK06BX222K
C6	34-28-820	Cap 82pF, 10%, 200V	81349	CK05BX820K
C7		Not used		
C8	34-27-101	Cap 100pF 10% 200V	81349	CK05BX101K
C9	34-27-221	Cap 220pF 10% 200V	81349	CK05BX221K
C10	34-19-3R3	Cap 3.3pF 1000V	71590	DD-3R3
C11	34-28-104	Cap .1μF 10% 100V	81349	CK06BX104K
C12	34-28-104	Cap .1μF 10% 100V	81349	CK06BX104K
C13	34-27-560	Cap 36pF 10% 200V	81349	CK05BX560K
C14	34-28-104	Cap .1μF 10% 100V	81349	CK06BX104K
C15	34-28-104	Cap .1μF 10% 100V	81349	CK06BX104K
C16	34-27-102	Cap 1000pF 10% 200V	81349	CK05BX102K
C17	34-27-222	Cap 2200pF 10% 100V	81349	CK05BX222K
C18	34-27-471	Cap 470pF 10% 200V	81349	CK05BX471K
C19	34-27-101	Cap 100pF 10% 200V	81349	CK05BX101K
C20	34-28-104	Cap .1μF 10% 100V	81349	CK06BX104K
C21	31-81	Cap Tant 10μF 25V	31433	T362B106M025AS
C22	31-81	Cap Tant 10μF 25V	31433	T362B106M025AS
C23	34-27-221	Cap 220pF 10% 200V	81349	CK05BX221K
C24	31-78	Cap Tant 1μF 35V	31433	T362A105M035AS
C25	34-28-104	Cap .1μF 10% 100V	81349	CK06BX104K
C26	31-78	Cap Tant 1μF 35V	31433	T362A105M035AS
C27	34-28-104	Cap .1μF 10% 100V	81349	CK06BX104K
C28	34-23-2R2	Cap 2.2μF 20% 50V	01884	7C25U225X0050E4
C29	34-27-221	Cap 220pF 10% 220V	81349	CK05BX221K
CR1	12-51	Diode, Signal	07688	1N3064
CR2	12-51	Diode, Signal	07688	1N3064
CR3	12-51	Diode, Signal	07688	1N3064
CR4	12-51	Diode, Signal	07688	1N3064
CR5	12-51	Diode, Signal	07688	1N3064
CR6	12-51	Diode, Signal	07688	1N3064
CR7	12-51	Diode, Signal	07688	1N3064
CR8	12-51	Diode, Signal	07688	1N3064
CR9	12-51	Diode, Signal	07688	1N3064
CR10	12-51	Diode, Signal	07688	1N3064
CR11	12-51	Diode, Signal	07688	1N3064
CR12	12-51	Diode, Signal	07688	1N3064

TABLE 6-5A. ASSEMBLY A1, LEVELER BOARD (C139-168-2) (Cont.)
(ALL UNITS EXCEPT 438A)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
CR13	12-51	Diode, Signal	07688	1N3064
CR14	12-51	Diode, Signal	07688	1N3064
CR15	12-51	Diode, Signal	07688	1N3064
CR16	12-51	Diode, Signal	07688	1N3064
CR17	12-50	Diode, Zener 5.1V	07688	1N751A
CR18	12-50	Diode, Zener 5.1V	07688	1N751A
*CR19	12-287	Diode, Constant Current	07688	1N5312
K1	47-29	Relay DPDT	12300	JRM1049
Q1	12-139	Transistor, NPN	07688	2N4401
Q2	12-139	Transistor, NPN	07688	2N4401
Q3	12-140	Transistor, PNP	07688	2N4403
Q4	12-139	Transistor, NPN	07688	2N4401
Q5	12-140	Transistor, PNP	07688	2N4403
Q6	12-139	Transistor, NPN	07688	2N4401
Q7	12-139	Transistor, NPN	07688	2N4401
Q8	12-139	Transistor, NPN	07688	2N4401
Q9	12-139	Transistor, NPN	07688	2N4401
Q10	12-140	Transistor, PNP	07688	2N4403
Q11	12-139	Transistor, NPN	07688	2N4401
Q12	12-139	Transistor, NPN	07688	2N4401
Q13	12-140	Transistor, PNP	07688	2N4403
Q14	12-139	Transistor, NPN	07688	2N4401
Q15	12-140	Transistor, PNP	07688	2N4403
Q16	12-140	Transistor, PNP	07688	2N4403
Q17	12-139	Transistor, NPN	07688	2N4401
Q18	12-202	Transistor N-J FET	07688	2N4092
Q19	12-139	Transistor, NPN	07688	2N4401
Q20	12-139	Transistor, NPN	07688	2N4401
Q21	12-139	Transistor, NPN	07688	2N4401
Q22	12-139	Transistor, NPN	07688	2N4401
Q23	12-139	Transistor, NPN	07688	2N4401
R1	25-25-3300	Resistor 3.3K 5% ¼W	81349	RC07GF332J
R2	25-20-845	Resistor 845Ω 1% 1/8W	81349	RN60C8450F
R3	25-25-150	Resistor 150Ω 5% ¼W	81349	RC07GF151J
R4	25-25-820	Resistor 820Ω 5% ¼W	81349	RC07GF821J
R5	25-25-1800	Resistor 1.8K 5% ¼W	81349	RC07GF182J
R6	25-25-220	Resistor 220Ω 5% ¼W	81349	RC07GF221J
R7	25-25-100	Resistor 100Ω 5% ¼W	81349	RC07GF101J
R8	25-25-15K	Resistor 15K 5% ¼W	81349	RC07GF153J
R9	25-20-2150	Resistor 2.15K 1% $^1/_8$ W	81349	RN60C2151F
R10	25-8-330	Resistor 330Ω 5% ½W	81349	RC07GF331J
R11		Not used		
R12	25-25-220	Resistor 220Ω 5% ¼W	81349	RC07GF221J
R13	25-8-200	Resistor 200Ω 5% ½W	81349	RC20GF201J
**R14	25-25-100	Resistor 100Ω 5% ¼W	81349	RC07GF101J
R15	25-25-1000	Resistor 1K 5% ¼W	81349	RC07GF102J
R16	20-184	Resistor variable 500Ω	32897	300GP-1-501
R17	25-25-4700	Resistor 4.7K 5% ¼W	81349	RC07GF472J
R18	25-25-1000	Resistor 1K 5% ¼W	81349	RC07GF102J
R19	25-25-1500	Resistor 1.5K 5% ¼W	81349	RC07GF152J

*Not used in earlier units
**Nominal value only; actual value selected at test.

TABLE 6-5A. ASSEMBLY A1, LEVELER BOARD (C139-168-2) (Cont.)
(ALL UNITS EXCEPT 438A)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R20	25-20-6040	Resistor 6.04K, 1%, 1/8 W	81349	RN60C6041F
R21	25-25-4700	Resistor 4.7K 5% ¼W	81349	RC07GF472J
R22	25-25-1800	Resistor 1.8K 5% ¼W	81349	RC07GF182J
R23	25-20-1470	Resistor 1.47K 1% 1/8W	81349	RN60C1471F
R24	25-25-560	Resistor 560Ω 5% ¼W	81349	RC07GF561J
R25	25-25-1000	Resistor 1K 5% ¼W	81349	RC07GF102J
R26	25-25-3000	Resistor 3K 5% ¼W	81349	RC07GF302J
R27	25-25-6200	Resistor 6.2K 5%, ¼W	81349	RC07GF022J
R28	25-25-33K	Resistor 33K 5% ¼W	81349	RC07GF333J
R29	25-25-15K	Resistor 15K 5% ¼W	81349	RC07GF153J
R30	25-25-3300	Resistor 3.3K 5% ¼W	81349	RC07GF332J
R31	25-25-150	Resistor 150Ω 5% ¼W	81349	RC07GF151J
R32	25-25-2200	Resistor 2.2K 5% ¼W	81349	RC07GF222J
R33	25-25-33K	Resistor 33K 5% ¼W	81349	RC07GF333J
R34	25-25-5600	Resistor 5.6K 5% ¼W	81349	RC07GF562J
R35	25-25-1500	Resistor 1.5K 5% ¼W	81349	RC07GF152J
R36	25-25-1500	Resistor 1.5K 5% ¼W	81349	RC07GF152J
R37	25-25-33K	Resistor 33K 5% ¼W	81349	RC07GF333J
R38	25-25-5600	Resistor 5.6K 5% ¼W	81349	RC07GF562J
R39	25-25-10K	Resistor 10K 5% ¼W	81349	RC07GF103J
R40	25-25-330K	Resistor 330K 5% ¼W	81349	RC07GF334J
R41	25-25-100K	Resistor 100K 5% ¼W	81349	RC07GF104J
R42	25-25-2200	Resistor 2.2K 5% ¼W	81349	RC07GF222J
R43	25-25-10K	Resistor 10K 5% ¼W	81349	RC07GF103J
R43	25-25-4700	Resistor 4.6K 5% ¼W (For "P" units)	81349	RC01GF472J
R44	20-189-50K	Resistor variable 50K	32997	300GP-1-503
R45	25-25-1000	Resistor 1K 5% ¼W	81349	RC07GF102J
R46	25-25-1000	Resistor 1K 5% ¼W	81349	RC07GF102J
R47	25-25-51K	Resistor 51K 5% ¼W	81349	RC07GF513J
R48	25-25-10K	Resistor 10K 5% ¼W	81349	RC07GF103J
R49	25-25-5600	Resistor 5.6K 5% ¼W	81349	RC07GF562J
R50	25-25-2200	Resistor 2.2K 5% ¼W	81349	RC07GF222J
R51	25-25-3200	Resistor 3.3K 5% ¼W	81349	RC07GF333J
R51	25-25-6800	Resistor 6.8K 5% ¼W (For "P" units)	81349	RC07GF682J
R52	25-25-150	Resistor 150Ω 5% ¼W	81349	RC07GF151J
R53	25-25-150	Resistor 150Ω 5% ¼W	81349	RC07GF151J
R54	25-25-150	Resistor 150Ω 5% ¼W	81349	RC07GF151J
R55	25-25-150	Resistor 150Ω 5% ¼W	81349	RC07GF151J
R56	25-25-150	Resistor 150Ω 5% ¼W	81349	RC07GF151J
R57	25-25-10	Resistor 10Ω 5% ¼W	81349	RC07GF100J
R58	25-25-220	Resistor 220Ω 5% ¼W	81349	RC07GF221J
R59	25-25-150	Resistor 150Ω 5% ¼W	81349	RC07GF151J
R60	25-25-2200	Resistor 2.2K 5% ¼W	81349	RC07GF222J
R61	25-25-3300	Resistor 3.3K 5% ¼W	81349	RC07GF332J
R62	25-25-10K	Resistor 10K 5% ¼W	81349	RC07GF103J
R63	25-25-10K	Resistor 10K 5% ¼W	81349	RC07GF103J
R64	25-25-56K	Resistor 56K 5% ¼W	81349	RC07GF563J
R65	25-25-150K	Resistor 150K 5% ¼W	81349	RC07GF154J
R66	25-25-1500	Resistor 1.5K 5% ¼W	81349	RC07GF152J

TABLE 6-5A. ASSEMBLY A1, LEVELER BOARD (C139-168-2) (Cont.)
(ALL UNITS EXCEPT 438A)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R67	25-25-1500	Resistor 1.5K 5% ¼W	81349	RC07GF152J
R68	25-25-2200	Resistor 2.2K 5% ¼W	81349	RC07GF222J
R69	25-25-100K	Resistor 100K 5% ¼W	81349	RC07GF104J
R70	25-25-4700	Resistor 4.7K 5% ¼W	81349	RC07GF472J
R71	25-25-2200	Resistor 22K 5% ¼W	81349	RC07GF222J
R72	25-25-10K	Resistor 10K 5% ¼W	81349	RC07GF103J
R73	25-25-27K	Resistor 27K 5% ¼W	81349	RC07GF273J
R74	25-25-5600	Resistor 5.6K 5% ¼W	81349	RC07GF562J
S1	B55-50	Switch, Pushbutton		
S2	55-52	Switch Slide DPDT	95146	MSS2250R
U1	12-195	Operational Amplifier	07263	MA7150C
U2	12-195	Operational Amplifier	07263	MA7150C
U3	12-163	DTL Quad 2 Input Nand	04713	MC846P
U4	12-192	Dual Operational Amplifier	04713	MC1458P

TABLE 6-5B. ASSEMBLY A1, LEVELER BOARD (C139-168-1) MODEL 438A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		This is a partial list of components unique to the 438A, A1 Assembly. Refer to Table 6-5A for a listing of components other than those in this list.		
C3	34-27-102	Cap, 1000pF, 10%, 200V (not used on earlier units)	81349	CK05BX102K
C5		Not Used		
C6		Not Used		
C7	34-27-560	Cap, 56pF, 10%, 200V	81349	CK05BX560K
C19	34-27-101	Cap 100 pF, 10%, 200V (used in earlier units)	81349	CK05BX101K
C19	34-27-331	Cap 330pF, 10%, 200V (used on later units)	81349	CK05BX531K
CR19	12-287	Diode, Constant Current	07688	IN5312
R9	25-20-2370	Resistor 2.37K, 1%, $^1/_8$W (used on earlier unit)	81349	RN60C2371F
R9	25-20-2150	Resistor 2.15K, 1%, $^1/_8$W (used on later units)	81349	RN60C2151F
***R14**	25-25-82	Resistor 82Ω, 5%, ¼W (used on earlier units)	81349	RC07GF820J
R20	25-20-4220	Resistor 422Ω, 1%, $^1/_8$W (used on earlier units)	81349	RN60C4221F
R20	25-20-6040	Resistor 6.04Ω, 1%, $^1/_8$ W (used on later units)	81349	RN60C6041F
R21	25-25-4700	Resistor 4.7K, 5%, ¼W (used on earlier units)	81349	RC07GF472J
R21	25-25-5600	Resistor 5.6K, 5%, ¼W (used on later units)	81349	RC07GF562J
R22	25-25-1800	Resistor 1.8K, 5%, ¼W (used on earlier units)	81349	RC07GF182J
R22	25-25-3300	Resistor 3.3K, 5%, ¼W (used on later units)	81349	RC07GF332J
R27	25-25-12K	Resistor 12K, 5%, ¼W	81349	RC07GF123J
R28	25-25-47K	Resistor 47K, 5%, ¼W	81349	RC07GF473J
R33	25-25-33K	Resistor 33K, 5%, ¼W (used on earlier units)	81349	RC07GF333K
R33	25-25-18K	Resistor 18K, 5%, ¼W (used on later units)	81349	RC07GF183J
R43	25-25-15K	Resistor 15K, 5%, ¼W	81349	RC07GF153J
R51	25-25-4700	Resistor 4.71K, 5%, ¼W	81349	RC07GF472J
R64	25-25-56K	Resistor 56K, 5%, ¼W (used on earlier units)	81349	RC07GF563J
R64	25-30-3832	Resistor 38.3K, 1%, $^1/_8$W (used on later units)	81349	RN35C3832F

***Nominal value only; actual value selected at test.**

TABLE 6-6. ASSEMBLY A2, TUNING AND BIAS SUPPLY MASTER PARTS LIST

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
	Table 6-6 represents a master parts list for Assembly A2. Refer to Table 6-2 to determine which assembly part number applies to a specific model RF Unit. Also, refer to Table 6-6A through 6-6I (as indicated throughout Table 6-6) for component values peculiar to the respective assemblies.			
A2				
C1	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
C2	34-27-151	Cap 150pF, 10%, 200V	81349	CK05BX151K
C3	34-27-103	Cap, .01μF, 10%, 100V	81349	CK05BX103K
C4	34-27-103	Cap, .01μF, 10%, 100V	81349	CK05BX103K
C5	31-80	Cap, tant, 10μF, 35V	31433	T362C106M035AS
C6	34-28-473	Cap, .047μF, 10%, 100V	81349	CK06BX473K
C7		See Specific Parts List		
C8	34-27-103	Cap, .01μF, 10%, 100V	81349	CK05BX103K
C9	34-27-103	Cap, .01μF, 10%, 100V	81349	CK05BX103K
C10		See Specific Parts List		
C11		See Specific Parts List		
C12		See Specific Parts List		
C13	34-27-332	Cap, 3300pF, 10%, 100V	81349	CK05BX332K
C14	34-27-103	Cap, .01μF, 10%, 100V	81349	CK05BX103K
C15	34-23-R22	Cap, .22μF, 20%, 50V	01884	7CZ5U224X005001
C16		See Specific Parts List		
C17	34-27-680	Cap, 68pF, 10%, 200V	81349	CK05BX680K
C18	34-28-104	Cap, 0.1μF, 10%, 100V	81349	CK06BX104K
C19	34-27-151	Cap, 150pF, 10%, 220V	81349	CK05BX151K
C20	34-28-104	Cap, 0.1μF, 10%, 100V	81349	CK06BX104K
C21	34-28-R47	Cap, 0.47μF, 20%, 50V	01884	7CZ5U474X005E1
C22	34-23-R33	Cap, 0.33μF, 20%, 50V	01884	7CZ5U334X005E1
C23	34-27-102	Cap, 1000pF, 10%, 200V	81349	CK05BX102K
C24	34-27-102	Cap, 1000pF, 10%, 200V	81349	CK05BX102K
C25	34-28-473	Cap, .047μF, 10%, 100V	81349	CK06BX473K
C26	34-27-471	Cap, 470pF, 10%, 200V	81349	CK05BX471K
C27	34-23-2R2	Cap, 2.2μF, 20%, 50V	01884	7C25U225K0050E4
C28	34-27-103	Cap, .01μF, 10%, 100V	81349	CK05BX103K
C29		See Specific Parts List		
C30	31-80	Cap, tantalum, 10μf, 35V	31433	T362C106M035AS
C31	34-23-R47	Cap, 0.47μF, 20%, 50V	01884	7C25V474X0050E1
C32	34-27-103	Cap, .01μF, 10%, 100V	81349	CK05BX103K
C33	34-27-681	Cap, 680pF, 10%, 200V	81349	CK05BX681K
C34		See Specific Parts List		
C35		See Specific Parts List		
C36		See Specific Parts List		
C37		See Specific Parts List		
C38		See Specific Parts List		
C39		See Specific Parts List		
C40		See Specific Parts List		
CR1	12-99	Diode, General Purpose	07688	1N483B
CR2	12-99	Diode, General Purpose	07688	1N483B
CR3	12-99	Diode, General Purpose	07688	1N483B
CR4	12-99	Diode, General Purpose	07688	1N483B
CR5	12-99	Diode, General Purpose	07688	1N483B
CR6	12-204	Diode, Zener, 4.7V	07688	1N750R
CR7	12-215	Diode, SCR	07688	2N4441

TABLE 6-6. ASSEMBLY A2, TUNING AND BIAS SUPPLY MASTER PARTS LIST (Cont.)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
CR8	12-110	Diode, Rectifier	07688	1N4383
CR9	12-99	Diode, General Purpose	07688	1N483B
CR10	12-99	Diode, General Purpose	07688	1N483B
CR11	12-99	Diode, General Purpose	07688	1N483B
CR12	12-110	Diode, Rectifier	07688	1N4383
CR13		See Specific Parts List		
CR14	12-99	Diode, General Purpose	07688	1N483B
CR15	12-99	Diode, General Purpose	07688	1N483B
CR16	12-99	Diode, General Purpose	07688	1N483B
CR17	12-99	Diode, General Purpose	07688	1N483B
CR18	12-99	Diode, General Purpose	07688	1N483B
CR19	12-99	Diode, General Purpose	07688	1N483B
CR20	12-99	Diode, General purpose	07688	1N483B
CR21	12-99	Diode, General Purpose	07688	1N483B
CR22	12-99	Diode, General Purpose	07688	1N483B
CR23	12-99	Diode, General Purpose	07688	1N483B
CR24	12-99	Diode, General Purpose	07688	1N483B
CR25	12-99	Diode, General Purpose	07688	1N483B
CR26	12-99	Diode, General Purpose	07688	1N483B
CR27	12-99	Diode, General Purpose	07688	1N483B
CR28	12-99	Diode, General Purpose	07688	1N483B
CR29	12-99	Diode, General Purpose	07688	1N483B
CR30	12-99	Diode, General Purpose	07688	1N483B
CR31	12-99	Diode, General Purpose	07688	1N483B
CR32	12-99	Diode, General Purpose	07688	1N483B
CR33	12-99	Diode, General Purpose	07688	1N483B
CR34	12-99	Diode, General Purpose	07688	1N483B
CR35	12-134	Diode, Zener, 8.2V	07688	1N756A
CR36	12-99	Diode, General Purpose	07688	1N483B
CR37	12-99	Diode, General Purpose	07688	1N483B
CR38	12-99	Diode, General Purpose	07688	1N483B
CR39	12-99	Diode, General Purpose	07688	1N483B
CR40	12-99	Diode, General Purpose	07688	1N483B
CR41	12-99	Diode, General Purpose	07688	1N483B
CR42	12-99	Diode, General Purpose	07688	1N483B
CR43	12-99	Diode, General Purpose	07688	1N483B
CR44	12-99	Diode, General Purpose	07688	1N483B
CR45	12-99	Diode, General Purpose	07688	1N483B
CR46		Not Used		
CR47		Not Used		
CR48	12-51	Diode, General Purpose	07688	1N3064
CR49		Not Used		
CR50	12-45	Diode, General Purpose	07688	1N250
CR51	12-51	Diode, General Purpose	07688	1N3064
F1		See Specific Parts List		
F2		See Specific Parts List		
K1	*47-34	Relay	71482	MABIA05

*Used on Rev L and up of PC Bd D139-108. For Rev K and below K1 is W/E Part No. 47-30, MFR Code 70109, MFR Part No. 1300GL.

TABLE 6-6. ASSEMBLY A2, TUNING AND BIAS SUPPLY MASTER PARTS LIST (Cont.)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
Q1	12-140	Transistor, PNP	07688	2N4403
Q2	12-139	Transistor, NPN	07688	2N4401
Q3	12-140	Transistor, PNP	07688	2N4403
Q4	12-194	Transistor, PNP	04713	MPS-U55
Q5	12-139	Transistor, NPN	07688	2N4401
Q6	12-140	Transistor, PNP	07688	2N4403
Q7	12-140	Transistor, PNP	07688	2N4403
Q8	12-222	Transistor, NPN (Dual)	07688	2N4045
Q9	12-222	Transistor, NPN (Dual)	07688	2N4045
Q10	12-140	Transistor, PNP	07688	2N4403
Q11	12-206	Transistor, NPN	04713	MPS-U05
Q12	12-194	Transistor, PNP	04713	MPS-U55
Q13		Not Used		
Q14	12-139	Transistor, NPN	07688	2N4401
Q15	12-139	Transistor, NPN	07688	2N4401
Q16	12-202	Transistor, FET	07688	2N4092
Q17	12-140	Transistor, PNP	07688	2N4403
Q18	12-140	Transistor, PNP	07688	2N4403
Q19		See Specific Parts List		
R1		See Specific Parts List		
R2		See Specific Parts List		
R3		See Specific Parts List		
R4	25-25-180	Resistor 180Ω, 5%, ¼W	81349	RC07GF181J
R5		See Specific Parts List		
R6	25-25-15K	Resistor, 15K, 5%, ¼W	81349	RC07GF153J
R7	25-25-22K	Resistor 22K, 5%, ¼W	81349	RC07GF223J
R8		See Specific Parts List		
R9	25-20-1960	Resistor, 1.96K, 1%, 1/8W	81349	RN60C1961F
R10		Select at Test		
R11	25-20-1960	Resistor 1.96K, 1%, 1/8W	81349	RN60C1961F
R12	25-25-2200	Resistor 2.2K, 5%, ¼W	81349	RC07GF222J
R13	25-25-220	Resistor 220Ω, 5%, ¼W	81349	RC07GF221J
R14	25-8-470	Resistor 470Ω, 5%, ½W	81349	RC206F471J
R15	25-25-470	Resistor 470Ω, 5%, ¼W	81349	RC07GF471J
R16	25-25-220	Resistor 220Ω, 5%, ¼W	81349	RC07GF221J
R17		See Specific Parts List		
R18	20-189-2K	Resistor, Variable 2K	32997	3006P-1-202
R19	25-20-12R1K	Resistor 12.1K, 1%, 1/8W	81349	RN60CI212F
R20	25-25-1000	Resistor 1K, 5%, ¼W	81349	RC07GF102J
R21	25-25-470	Resistor 470Ω, 5%, ¼W	81349	RC07GF471J
R22		See Specific Parts List		
R23		See Specific Parts List		
R24	25-8-1800	Resistor, 1.8K, 5%, ½W	81349	RC20GF182J
R25		See Specific Parts List		
R26		See Specific Parts List		
R27		See Specific Parts List		
R28	25-20-10K	Resistor 10K, 1%, 1/8W	81349	RN60C1002F
R29	25-28-10K	Resistor 10K, 1%, 1/8W	81349	RN6OE1002F

TABLE 6-6. ASSEMBLY A2, TUNING AND BIAS SUPPLY MASTER PARTS LIST (Cont.)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R30		Select at Test		
R31		See Specific Parts List		
R32	25-20-1M	Resistor 1M, 1%, 1/8W	81349	RN60C1004F
R33	25-20-1M	Resistor 1M, 1%, 1/8W	81349	RN60C1004F
R34	25-20-750K	Resistor 750K, 1%, 1/8W	81349	RN60C7503F
R35	25-20-1300	Resistor, 1.3K, 1%, 1/8W	81349	RN6OC1301F
R36		See Specific Parts List		
R37	25-25-2000	Resistor, 2K, 5%, ¼W	81349	RC07GF202J
R38	25-25-3300	Resistor, 3.3K, 5%, ¼W	81349	RC07GF332J
R39	25-25-3300	Resistor, 3.3K, 5%, ¼W	81349	RC07GF332J
R40		See Specific parts List		
R41	25-25-15K	Resistor, 15K, 5%, ¼W	81349	RC07GF153J
R42	25-25-200	Resistor, 200Ω, 5%, ¼W	81349	RC07GF201J
R43	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R44*	25-25-150	Resistor, 150Ω, 5%, ¼W	81349	RC07GF151J
R45		See Specific Parts List		
R46	25-25-10	Resistor 10Ω, 5%, ¼W	81349	RC07GF100J
R47	25-25-10	Resistor, 10Ω, 5%, ¼W	81349	RC07GF100J
R48	25-25-2200	Resistor 2.2K, 5%, ¼W	81349	RC07GF222J
R49		See Specific parts List		
R50	20-189-500K	Resistor Variable 500K	32997	3006P-1-504
R51		See Specific Parts List		
R52		See Specific Parts List		
R53	25-25-4700	Resistor, 4.7K, 5%, ¼W	81349	RC07GF472J
R54	25-20-475K	Resistor, 475K, 1%, 1/8W	81349	RN60C4753F
R55	25-20-475K	Resistor, 475K, 1%, 1/8W	81349	RN60C4753F
R56	25-25-330K	Resistor, 330K, 5%, ¼W	81349	RC07GF334J
R57	25-25-56K	Resistor, 56K, 5%, ¼W	81349	RC07GF563J
R58	25-25-2200	Resistor, 2.2K, 5%, ¼W	81349	RC07GF222J
R59	25-25-150K	Resistor, 150K, 5%, ¼W	81349	RC07GF154J
R60	25-25-390	Resistor, 390Ω, 5%, ¼W	81349	RC07GF391J
R61		See Specific Parts List		
R62	25-25-220	Resistor, 220Ω, 5%, ¼W	81349	RC07GF221J
R63	25-23-2R43K	Resistor, 2.43K, 0.1%, 1/8W	81349	RN60E2431B
R64	25-23-2R43K	Resistor, 2.43K, 0.1%, 1/8W	81349	RN60E2431B
R65	25-23-100	Resistor, 100Ω, 0.1%, 1/8W	81349	RN60E1000B
R66	25-23-100	Resistor, 100Ω, 0.1%, 1/8W	81349	RN60E1000B
R67	25-25-220	Resistor, 220Ω, 5%, ¼W	81349	RC07GF221J
R68	25-25-1500	Resistor, 1.5K, 5%, ¼W	81349	RC07GF152J
R69	25-23-243K	Resistor, 243K, 0.1%, 1/8W	81349	RN60E2433B
R70	25-23-243K	Resistor, 243K, 0.1%, 1/8W	81349	RN60E2433B
R71	25-25-470	Resistor, 470Ω, 5%, ¼W	81349	RC07GF471J
R72	25-25-820	Resistor, 820Ω, 5%, ¼W	81349	RC07GF821J
R73	25-25-2200	Resistor, 2.2K, 5%, ¼W	81349	RC07GF222J
R74	25-25-150K	Resistor, 150K, 5%, ¼W	81349	RC07GF154J
R75	25-25-1R8M	Resistor, 1.8M, 5%, ¼W	81349	RC07GF185J
R76	25-25-390	Resistor, 390Ω, 5%, ¼W	81349	RC07GF391J
R77	25-8-910	Resistor, 910Ω, 5%, ½W	81349	RC20GF911J
R78	25-25-1000	Resistor 1K, 5%, ¼W	81349	RC07GF102J
R79	25-20-221K	Resistor, 221K, 1%, 1/8W	81349	RN60C2213F

*Different Part used on some Models 435A/4309A. See page 6-29 (P/L 139-109-27).

TABLE 6-6. ASSEMBLY A2, TUNING AND BIAS SUPPLY MASTER PARTS LIST (Cont.)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R80	25-20-221K	Resistor, 221K, 1%, 1/8W	81349	RN60C2213F
R81	25-25-39K	Resistor, 39K, 5%, ¼W	81349	RC07GF393J
R82	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R83	25-20-68R1K	Resistor, 68.1K, 1%, 1/8W	81349	RN60C6812F
R84	25-20-68R1K	Resistor 68.1K, 1%, 1/8W	81349	RN60C6812F
R85		See Specific Parts List		
R86		See Specific Parts List		
R87	20-189-100K	Resistor, Variable, 100K	32997	3006P-1-104
R88		See Specific Parts List		
R89	20-289-200K	Resistor, Variable, 200K	32997	3006P-1-204
R90	25-25-33K	Resistor 33K, 5%, ¼W	81349	RC07GF333J
R91	25-25-1800	Resistor, 1.8K, 5%, ¼W	81349	RC07GF182J
R92	25-25-10M	Resistor 10M, 5%, ¼W	81349	RC07GF106J
R93	25-25-20K	Resistor, 20K, 5%, ¼W	81349	RC07GF203J
R94	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R95	25-25-20K	Resistor, 20K, 5%, ¼W	81349	RC07GF203J
R96	25-25-4700	Resistor, 4.7K, 5%, ¼W	81349	RC07GF472J
R97	25-20-475K	Resistor, 475K, 1%, 1/8W	81349	RN60C4753F
R98	25-20-475K	Resistor, 475K, 1%, 1/8W	81349	RN60C4753F
R99	25-25-20K	Resistor, 20K, 5%, ¼W	81349	RC07GF203J
R100	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R101	25-25-120K	Resistor, 120K, 5%, ¼W	81349	RC07GF124J
R102	25-25-6800	Resistor, 6.8K, 5%, ¼W	81349	RC07GF682J
R103	25-25-220	Resistor, 220Ω, 5%, ¼W	81349	RC07GF221J
R104		See Specific Parts List		
R105		Select at Test		
R106	25-25-2R2M	Resistor, 2.2M, 5%, ¼W	81349	RC07GF225J
R107		See Specific Parts List		
R108	20-189-200K	Resistor, Variable, 200K	32997	3006P-1-204
R109	25-25-47K	Resistor, 47K, 5%, ¼W	81349	RC07GF473J
R110	25-25-330K	Resistor, 330K, 5%, ¼W	81349	RC07GF334J
R111	25-25-68K	Resistor, 68K, 5%, ¼W	81349	RC07GF683J
R112	25-25-22K	Resistor, 22K, 5%, ¼W	81349	RC07GF223J
R113	25-25-100K	Resistor, 100K, 5%, ¼W	81349	RC07GF104J
R114	25-25-7500	Resistor, 7.5K, 5%, ¼W	81349	RC07GF752J
R115	25-25-22K	Resistor, 22K, 5%, ¼W	81349	RC07GF223J
R116	25-25-22K	Resistor, 22K, 5%, ¼W	81349	RC07GF223J
R117	25-25-22K	Resistor, 22K, 5%, ¼W	81349	RC07GF223J
R118	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R119	25-25-560K	Resistor, 560K, 5%, ¼W	81349	RC07GF564J
R120	25-25-1500	Resistor, 1.5K, 5%, ¼W	81349	RC07GF152J
R121	25-25-3300	Resistor, 3.3K, 5%, ¼W	81349	RC07GF332J
R122	25-25-3300	Resistor, 3.3K, 5%, ¼W	81349	RC07GF332J
R123	25-25-39K	Resistor, 39K, 5%, ¼W	81349	RC07GF393J
R124	25-25-470	Resistor, 470Ω, 5%, ¼W	81349	RC07GF471J
R125		Not Used		
R126		Not Used		
R127		Not Used		
R128		Not Used		

TABLE 6-6. ASSEMBLY A2, TUNING AND BIAS SUPPLY MASTER PARTS LIST (Cont.)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R129		See Specific Parts List		
R130		See Specific Parts List		
R131	25-25-1800	Resistor, 1.8K, 5%, ¼W	81349	RC07GF182J
R132	25-25-7500	Resistor, 7.5K, 5%, ¼W	81349	RC07GF752J
R133	25-25-47K	Resistor, 47K, 5%, ¼W	81349	RC07GF473J
R134		See Specific Parts List		
R135		See Specific Parts List		
R136		See Specific Parts List		
R137		See Specific Parts List		
R138	25-20-10K	Resistor, 10K, 1%, 1/8W	81349	RN60C1002F
R139		Select at Test		
R140		See Specific Parts List		
R141		Not Used		
R142		See Specific Parts List		
R143*				
		*For A2 boards D139-108 of Rev. L and up. On some units with A2 boards (D139-108) at Rev. K, this resistor occupies the R135 position.		
R144	025-25-15K	Resistor, 15K, 5%, 1/4W	81349	RC07GF153J
U1	12-165	Operational Amplifier	27014	LM301AH
U2	12-165	Operational Amplifier	27014	LM301AH
U3	12-165	Operational Amplifier	27014	LM301AH
U4	12-192	Dual Operational Amplifier	04713	MC1458P
U5	12-192	Dual Operational Amplifier	04713	MC1458P
U6	12-192	Dual Operational Amplifier	04713	MC1458P
U7	12-192	Dual Operational Amplifier	04713	MC1458P
U8	12-172	Transistor Arry	86684	CA3046

*A jumper is used in place of R141.

TABLE 6-6A. ASSEMBLY A2, TUNING AND BIAS SUPPLY (C139-109-20) MODEL 431A SERIES

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		This is a partial list for components unique to Assembly A2, (C139-109-20). Refer to Master Parts List Table 6-6, for a complete listing.		
C7	34-27-472	Cap, 4700pF, 10%, 100V	81349	CK05BX472K
C10*	34-27-332	Cap, 3300pF, 20%, 100V	81349	CK05BX332K
C10	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
C11		**Not Used**		
C12	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
C16*	34-27-472	Cap, 4700pF, 10%, 100V	81349	CK05BX472K
C16	34-27-152	Cap, 1500pF, 10%, 100V	81349	CK05BX152K
C29*	34-27-472	Cap, 4700pF, 10%, 100V	81349	CK05BX472K
C29	34-27-470	Cap, 470pF, 10%, 100V	81349	CK05BX470K
C34	34-27-330	Cap, 330pF, 10%, 200V	81349	CK05BX330K
C35*		Not Used		
C35	34-28-104	Cap, .01μF, 10%, 100V	81349	CK06BX104K
C36*		Not Used		
C36	31-80	Cap, Tantalum, 10μF, 35V	34133	T362C106M035AS
C37*		Not Used		
C37	31-80	Cap, Tantalum, 10μF, 35V	34133	T362C106M035AS
C38		Select at test		
C39*		Not Used		
C39	34-27-681	Cap, 680pF, 10%, 200V	81349	CK05BX330K
C40*		Not Used		
C40	34-27-103	Cap, .01μF, 10%, 200V	81349	CK05BX103K
CR13	12-19€	Diode, Zener 15V	07688	IN4744A
F1	52-1-$^{3}/_{4}$	Fuse, $^{3}/_{4}$ Amp	00000	AGC $^{3}/_{4}$ Amp
F2	52-1-¼	Fuse, ¼ Amp	00000	AGC ¼ Amp
R1	25-25-33	Resistor, 33 ohm, 5%, ¼W	81349	RC07GF330J
R2*	26-20-R75	Resistor, WW, .75 ohm, 5%, 2W	81349	RW8OUR75J
R2	26-30-1R78	Resistor, 1.78 ohm, 1%, 3W	81349	RW79U1R78F
R3*	25-8-2400	Resistor, 2.4K, 5%, ½W	81349	RC20GF242J
R3	25-25-2200	Resistor, 2.2K, 5%, ¼W	81349	RC07GF222J
R5		Not Used		
R8		Select at test		
R17		Not Used		
R22	26-67-8R66	Resistor, 8.66 ohm, 1%, 1W	81349	RW70U8R66
R23*	25-20-680	Resistor, 680 ohm, 5%, ¼W	81349	RC07GF681J
R23	25-20-470	Resistor, 470 ohm, 5%, ¼W	81349	RC07GF471J
R25	25-25-3300	Resistor, 3.3K, 5%, ¼W	81349	RC07GF332J
R26		**Not Used**		
R27	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R31	20-203-202	Resistor, Variable, 2K	32997	3009P-1-202
R36	25-25-5100	Resistor, 5.1K, 5%, ¼W	81349	RC07GF512J
R40	25-25-6800	Resistor, 6.8K, 5%, ¼W	81349	RC07GF082J
R45	25-9-47	Resistor, 47 ohm, 5%, 1W	81349	RC32GF470J
R49	25-9-47	Resistor, 47 ohm, 5%, 1W	81349	RC32GF470J
R51	25-25-150K	Resistor, 150K, 5%, ¼W	81349	RC07GF154J

*Rev F only

TABLE 6-6A. ASSEMBLY A2, TUNING AND BIAS SUPPLY (C139-109-20) MODEL 431A SERIES (Cont.)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R52	25-20-69R8K	Resistor, 69.8K, 1%, $^1/_8$W	81349	RN60CB982F
R61*	25-25-330K	Resistor, 330K, 5%, ¼W	81349	RC07GF334J
R61	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R85	25-8-33	Resistor, 33 ohm, 5%, ½W	81349	RC20GF330J
R86	25-20-178K	Resistor, 178K, 1%, $^1/_8$W	81349	RN60C1783F
R88	25-20-562K	Resistor, 562K, 1%, $^1/_8$W	81349	RN60C5623F
R104	20-203-501	Resistor, Variable, 500 ohm	32997	3009P-1-501
R107	25-20-221K	Resistor, 221K, 1%, $^1/_8$W	81349	RN60C2213F
R129*	25-20-348K	Resistor, 348K, 1%, $^1/_8$W	81349	RN60C3483F
R129		Select at test		
R130*	25-20-348K	Resistor, 348K, 1%, $^1/_8$W	81349	RN60C3483F
R130		Select at test		
R134		Not Used		
R135		Not Used		
R136		Not Used		
R137*	25-25-1.8M	Resistor, 1.8M, 5%, ¼W		RC07GF185J
R137	25-25-4R7M	Resistor,4.7M, 5%, ¼W		RC07GF475J
R140		Not Used		
R142		Not Used		
R143		Select at test		
R144	**025-25-15K**	**Resistor, 15K, 5%, 1/4W**	**81349**	**RC07GF153J**

*Rev F only

TABLE 6-6B. ASSEMBLY A2, TUNING AND BIAS SUPPLY (C139-109-21) MODEL 432A SERIES

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
	This is a partial list for components unique to Assembly A2, (C139-109-21). Refer to Master Parts List Table 6-6, for a complete listing.			
C7	34-27-472	Cap, 4700pF, 10%, 100V	81349	CK05BX472K
C10	34-27-332	Cap, 3300pF, 10%, 100V	81349	CK05BX332K
C11		Not Used		
C12	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
C16	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
C29	34-27-470	Cap, 470pF, 10%, 100V	81349	CK05BX470K
C34	34-27-330	Cap, 330pF, 10%, 200V	81349	CK05BX330K
C35*		Not Used		
C35	34-28-104	Cap, .01μF, 10%, 100V	81349	CK06BX104K
C36*		Not Used		
C36	31-80	Cap, Tantalum, 10μF, 35V	34133	T362C106M035AS
C37*		Not Used		
C37	31-80	Cap, Tantalum, 10μF, 35V	34133	T362C106M035AS
C38		Select at test		
C39*		Not Used		
C39	34-27-681	Cap, 680pF, 10%, 200V	81349	CK05BX330K
C40*		Not Used		
C40	34-27-103	Cap, .01μF, 10%, 200V	81349	CK05BX103K
CR13	12-196	Diode, Zener 15V	07688	1N4744A
F1	52-1-¾	Fuse, ¾ Amp	00000	AGC ¾ Amp
F2	52-1-¼	Fuse, ¼ Amp	00000	AGC ¼ Amp
R1	25-25-33	Resistor, 33 ohm, 5%, ¼W	81349	RC07GF330J
R2*	26-20-R75	Resistor WW, .75 ohm, 5%, 2W	81349	RW80UR75J
R2	26-30-1R78	Resistor, 1.78 ohm, 1%, 3W	81349	RW79U1R78F
R3*	25-25-1800	Resistor, 1.8K, 5%, ¼W	81349	RC07GF182J
R3	25-25-2200	Resistor, 2.2K, 5%, ¼W	81349	RC07GF222J
R5		Not Used		
R8		Select at test		
R17	26-42-220	Resistor, WW, 220 ohm, 3%, 3W	81349	RS2A201±3%
R22	26-67-8R66	Resistor, 8.66 ohm, 1%, 1W	81349	RW70U8R66
R23*	25-20-680	Resistor, 680 ohm, 5%, ¼W	81349	RC07GF681J
R23	25-20-470	Resistor, 470 ohm, 5%, ¼W	81349	RC07GF471J
R25	25-25-3300	Resistor, 3.3K, 5%, ¼W	81349	RC07GF332J
R26		Not Used		
R27	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R31	20-203-202	Resistor, Variable, 2K	32997	3009P-1-202
R36	25-25-5100	Resistor, 5.1K, 5%, ¼W	81349	RC07GF512J
R40	25-25-12K	Resistor, 12K, 5%, ¼W	81349	RC07GF123J
R45	25-9-100	Resistor, 100 ohm, 5%, 1W	81349	RC32GF101J
R49	25-9-100	Resistor, 100 ohm, 5%, 1W	81349	RC32GF101J
R51	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R52	25-20-69R8K	Resistor, 69.8K, 1%, ⅛W	81349	RN60CB982F
R61	25-25-100K	Resistor, 100K, 5%, ¼W	81349	RC07GF104J

*Rev F only

TABLE 6-6B. ASSEMBLY A2, TUNING AND BIAS SUPPLY (C139-109-21) MODEL 432A SERIES (Cont.)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R85	25-8-33	Resistor, 33 ohm, 5%, ½W	81349	RC20GF330J
R86	25-20-121K	Resistor, 121K, 1%, $^1/_8$W	81349	RN60C1213F
R88	25-20-267K	Resistor, 267K, 1%, $^1/_8$W	81349	RN60C2673F
R104	20-203-501	Resistor, Variable, 500 ohm	32997	3009P-1-501
R107	25-20-150K	Resistor, 150K, 1%, $^1/_8$W	81349	RN60C1503F
R129	25-20-348K	Resistor, 348K, 1%, $^1/_8$W	81349	RN60C3483F
R130	25-20-348K	Resistor, 348K, 1%, $^1/_8$W	81349	RN60C3483F
R134		Not Used		
R135		Not Used		
R136		Not Used		
R137	25-25-1.8M	Resistor, 1.8M, 5%, ¼W	81349	RC07GF185J
R140		Not Used		
R142		Not Used		
R143		Select at test		
R144	025-25-15K	Resistor, 15K, 5%, 1/4W	81349	RC07GF153J

TABLE 6-6C. ASSEMBLY A2, TUNING AND BIAS SUPPLY (C139-109-15) MODEL 433A SERIES

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		This is a partial list for components unique to Assembly A2, (C139-109-15). Refer to Master Parts List Table 6-6, for a complete listing.		
C7	34-27-472	Cap, 4700pF, 10%, 100V	81349	CK05BX472K
C10	34-27-332	Cap, 3300pF, 10%, 100V	81349	CK05BX332K
C11	25-25-51K	Resistor, 51K, 5%, 1/4W	81349	RC07GF513J
C12	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
C16	34-27-472	Cap, 4700pF, 10%, 100V	81349	CK05BX472K
C29	34-27-470	Cap, 470pF, 10%, 100V	81349	CK05BX470K
C34	34-27-330	Cap, 330pF, 10%, 200V	81349	CK05BX330K
C35*		Not Used		
C35	34-28-104	Cap, .01μF, 10%, 100V	81349	CK06BX104K
C36*		Not Used		
C36	31-80	Cap, Tantalum, 10μF, 35V	34133	T362C106M035AS
C37*		Not Used		
C37	31-80	Cap, Tantalum, 10μF, 35V	34133	T362C106M035AS
C38		Select at test		
C39*		Not Used		
C39	34-27-681	Cap, 680pF, 10%, 200V	81349	CK05BX330K
C40*		Not Used		
C40	34-27-103	Cap, .01μF|,10%, 200V	81349	CK05BX103K
CR13	12-196	Diode, Zener 15V	07688	1N4744A
F1	52-1-3/4	Fuse, 3/4 Amp	00000	AGC 3/4 Amp
F2	52-1-3/4	Fuse, 3/4 Amp	00000	AGC 3/4 Amp
R1	25-25-33	Resistor, 33 ohm, 5%, ¼W	81349	RC07GF330J
R2*	26-20-R75	Resistor WW, .75 ohm, 5%, 2W	81349	RW8OUR75J
R2	26-30-1R78	Resistor, 1.78 ohm, 1%, 3W	81349	RW79U1R78F
R3*	25-25-2400	Resistor, 2.4K, 5%, ¼W	81349	RC07GF222J
R3	25-25-2200	Resistor, 2.2K, 5%, ¼W	81349	RC07GF222J
R5		Not Used		
R8		Select at test		
R17		Not Used		
R22	26-30-2R75	Resistor, WW, 2.75 ohm, 1%, 3W	81349	RW79U2R75F
R23*	25-20-680	Resistor, 680 ohm, 5%, ¼W	81349	RC07GF681J
R23	25-20-470	Resistor, 470 ohm, 5%, ¼W	81349	RC07GF471J
R25	25-25-3300	Resistor, 3.3K, 5%, ¼W	81349	RC07GF332J
R26		Not Used		
R27	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R31	20-203-202	Resistor, Variable, 2K	32997	3009P-1-202
R36	25-25-5100	Resistor, 5.1K, 5%, ¼W	81349	RC07GF512J
R40	25-25-12K	Resistor, 12K, 5%, ¼W	81349	RC07GF123J
R45	25-9-100	Resistor, 100 ohm, 5%, 1W	81349	RC32GF101J
R49	25-9-100	Resistor, 100 ohm, 5%, 1W	81349	RC32GF101J
R51	25-25-150K	Resistor, 150K, 5%, ¼W	81349	RC07GF154J
R52	25-20-69R8K	Resistor, 69.8K, 1%, 1/8W	81349	RN60C0982F

*Rev F only

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R61	25-25-150K	Resistor, 150K, 5%, ¼W	81349	RC07GF154J
R85	25-8-15	Resistor, 15 ohm, 5%, ½W	81349	RC20GF150J
R86	25-20-169K	Resistor, 169K, 1%, $^1/_8$W	81349	RN60C1693F
R88	25-20-422K	Resistor, 422K, 1%, $^1/_8$W	81349	RN60C4223F
R104	20-203-501	Resistor, Variable, 500 ohm	32997	3009P-1-501
R107	25-20-221K	Resistor, 221K, 1%, $^1/_8$W	81349	RN60C2213F
R129	25-20-133K	Resistor, 133K, 1%, $^1/_8$W	81349	RN60C1333F
R130	25-20-133K	Resistor, 133K, 1%, $^1/_8$W	81349	RN60C1333F
R134		Not Used		
R135		Not Used		
R136		Not Used		
R137	25-25-1.8M	Resistor, 1.8M, 5%, ¼W	81349	RC07GF185J
R140	26-30-147	Resistor, WW, 147 ohm, 1%, 3W	81349	RW179U1470F
R142		Not Used		
R143		Select at test		
R144	**025-25-15K**	**Resistor, 15K, 5%, 1/4W**	**81349**	**RC07GF153J**

TABLE 6-6D. ASSEMBLY A2, TUNING AND BIAS SUPPLY (C139-109-23)
MODEL 434A SERIES

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		This is a partial list for components unique to Assembly A2, (C139-109-23). Refer to Master Parts List Table 6-6, for a complete listing.		
C7	34-27-472	Cap, 4700 pF, 10%, 100V	81349	CK05BX472K
C10	34-27-332	Cap, 3300pF, 10%, 100V	81349	CK05BX332K
C11		Not Used		
C12	34-27-222	Cap, 2200 pF, 10%, 100V	81349	CK05BX222K
C16	34-27-472	Cap, 4700 pF, 10%, 100V	81349	CK05BX472K
C29	34-27-682	Cap, 6800 pF, 10%, 100V	81349	CK05BX682K
C34	34-27-330	Cap, 330 pF, 10%, 200V	81349	CK05BX330K
C35	34-28-104	Cap,.01μF, 10%, 100V	81349	CK06BX104K
C36	31-80	Cap, Tantalum, 10μF, 35V	34133	T362C106MOJ5AS
C37	31-80	Cap, Tantalum, 10μF, 35V	34133	T362C106MOJ5AS
C38		Select at test		
C39	34-27-681	Cap, 680 pF, 10%, 300V	81349	CK05BX330K
C40	34-27-103	Cap, .01μF, 10%, 200V	81349	CK05BX103K
CR13	12-196	Diode Zener 15V	07688	IN4744A
F1	52-1-¾	Fuse ¾ Amp	00000	AGC¾AMP
F2	52-1-1	Fuse 1 Amp	00000	AGC1AMP
R1	25-25-33	Resistor, 33 ohm, 5%, ¼W	81349	RC07GF330J
R2	26-30-1R78	Resistor, 1.78Ω, 1%, 3W	81349	RW79UR78F
R3	25-25-2200	Resistor, 2.2K, 5%, ¼W	81349	RC07GF222J
R5		Not used		
R8		Select at test		
R17		Not used		
R22	26-30-2R75	Resistor, WW, 2.75Ω, 1%, 3W	81349	RW79U2R75F
R23	25-20-470	Resistor, 470Ω, 5%, ¼W	81349	RC07GF471J
R25	25-25-3800	Resistor, 3.9K, 5%, ¼W	81349	RC07GF392J
R26		Not Used		
R27	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R31	20-203-202	Resistor, Variable, 2K	32997	3009P-1-202
R36	25-25-12K	Resistor, 5.1K, 5%, ¼W	81349	RC07GF512J
R40	25-25-12K	Resistor, 12K, 5%, ¼W	81349	RC07GF123J
R45	25-9-100	Resistor, 100Ω, 5%, .1W	81349	RC32GF101J
R49	25-9-100	Resistor, 100Ω, 5%, .1W	81349	RC07GF513J
R51	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R52	25-20-33R3K	Resistor, 33.2K, 1%, 1/8W	81349	RN60C3322F
R61	25-25-68K	Resistor, 68K, 5%, ¼W	81349	RC07GF683J
R85	25-8-15	Resistor, 15Ω, 5%, ½W	81349	RC20GF150J
R86	25-20-150K	Resistor, 150K, 1%, 1/8W	81349	RN60C1503F
R88	25-20-169K	Resistor, 169K, 1%, 1/8W	81349	RN60C1693F
R104*	20-203-501	Resistor, Variable, 500 ohm	32997	3009P-1-501
R104	20-203-201	Resistor, Variable, 200 ohm	32997	309P-1-201
R107	25-20-221K	Resistor, 221K, 1%, 1/8W	81349	RN60C2213F
R129	25-20-178K	Resistor, 178K, 1%, 1/8W	81349	RN60C1785F
R130	25-20-178K	Resistor, 178K, 1%, 1/8W	81349	RN60C1783F
R134		Not used		
R135		Not used		

*On earlier units

TABLE 6-6D. ASSEMBLY A2, TUNING AND BIAS SUPPLY (C139-109-23) (Cont.)
MODEL 434A SERIES

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R136		Not used		
R137	25-25-1.8M	Resistor, 1.8M 5%, ¼W		RC07GF185J
R140		Not used		
R142		Not used		
R143		Select at test		

TABLE 6-6E. ASSEMBLY A2, TUNING AND BIAS SUPPLY (C139-109-12)
MODEL 435A AND 435A/4309A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		This is a partial list for components unique to Assembly A2, (C139-109-12). Refer to Master Parts List Table 6-6, for a complete listing.		
C7**	34-27-222	Cap, 2200 pF, 10%, 100V	81349	CK05BX222K
C10	34-27-332	Cap, 330 pF, 10%, 100V	81349	CK05BX332K
C11		**Not Used**		
C12**	34-27-222	Cap, 2200 pF, 10%, 100V	81349	CK05BX222K
C16	34-27-6800	Cap, 6800 pF, 10%, 100V	81349	CK05BX682K
C29	34-27-6800	Cap, 6800 pF, 10%, 100V	81349	CK05BX682K
C34		Not used		
C35*		Not used		
C35	34-28-104	Cap, .01μF, 10%, 100V	81349	CK06BX104K
C36*		Not used		
C36	31-80	Cap, Tantalum, 10μF, 35V	34133	T362C106MOJ5AS
C37*		Not used		
C37	31-80	Cap, Tantalum, 10μF, 35V	34133	T362C106MOJ5AS
C38**		Select at test		
C39*		Not used		
C39	34-27-681	Cap, 680 pF, 10%, 200V	81349	CK05BX330K
C40*		Not used		
C40	34-27-103	Cap, .01μF, 10%, 200V	81349	CK05BX103K
CR13	12-196	Diode Zener 15V	07688	IN4744A
F1	52-1-1½	Fuse 1½Amp	00000	AGC1½AMP
F2	52-1-1½	Fuse 1½ Amp	00000	AGC1½AMP
R1	25-25-82	Resistor, 82Ω, 5%, ¼W	81349	RC07GF820J
R2*	26-20-R68	Resistor, 1Ω, 5%, 2W, WW	81349	RWH-1-5%
R2**	26-20-R68	Resistor, 68Ω, 5%, 2W, WW	81349	BWH-R68-5%
R3	25-8-1000	Resistor, 1K, 5%, ½W	81349	RC20GF102J
R5		Not used		
R8**		Select at test		
R17		Not used		
R22	26-29-1R40	Resistor, WW, 1.4Ω, 1%, 3W	81349	RW79U1R40F
R23*	25-20-680	Resistor, 680Ω, 5%, ¼W	81349	RC07GF631J
R23	25-20-470	Resistor, 470Ω, 5%, ¼W	81349	RC07GF471J
R25**	25-25-3900	Resistor, 3.9K, 5%, ¼W	81349	RC07GF392J
R26		**Not Used**		
R27	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R31	20-203-501	Resistor, Variable, 500Ω	32997	3009P-1-501
R36	25-25-5100	Resistor, 5.1K, 5%, ¼W	81349	RC07GF512J
R40**	25-25-12K	Resistor, 12K, 5%, ¼W	81349	RC07GF123J
R45**	25-9-47	Resistor, 47Ω, 5%, 1W	81349	RC32GF470J
R49**	25-9-47	Resistor, 47Ω, 5%, 1W	81349	RC43GF470J
R51	25-25-150K	Resistor, 150K, 5%, ¼W	81349	RC07GF154J
R52	25-20-20R7K	Resistor, 26.7K, 1%, 1/8W	81349	RN60C2672F
R61**	25-25-220K	Resistor, 220K, 5%, ¼W	81349	RC07GF224J
R85	25-8-6R8	Resistor, 6.8Ω, 5%, ½W	81349	RC20GF6R8J
R86	25-20-121K	Resistor, 121K, 1%, 1/8W	81349	RN60C1213F

*Used on REV. F only

**See page 6-29

TABLE 6-6E. ASSEMBLY A2, TUNING AND BIAS SUPPLY (C139-109-12) (Cont.)
MODELS 435A and 435A/4309A

REF. DES.	WEINSCHEL PART NO.	DESCRIPTION	MFG. PART NO.	MFG. CODE
R88	025-20-150K	Resistor 150K, 1%, 1/8W	RN60C1503F	81349
R104	020-203-204	Resistor, Variable, 200K	3009P-1-204	81349
R107	025-20-150K	Resistor, 150K, 1%, 1/8W	RN60C1503F	81349
R129**	025-20-115K	Resistor, 115K, 1%, 1/8W	RN60C1153F	81349
R130**	025-20-115K	Resistor, 115K, 1%, 1/8W	RN60C1153F	81349
R134		Not used		
R135		Not used		
R136		Not used		
R137	025-25-1.8M	Resistor, 1.8 5%, 1/4W	RC07GF185J	81349
R140		Not used		
R142**		Select at test		
R143		Select at test		
R144	025-25-15K	Resistor, 15K, 5%, 1/4W	RC07GF153J	81349

* For 435A/4309A units with an A2 Board (139-108) at Rev. Level "L" or higher, use the values on the following table. For these units the parenthetical part number is D139-109-27.

REF. DES.	WEINSCHEL PART NO.	DESCRIPTION	MFG. PART NO.	MFG. CODE
C7	34-27-472	Cap, 4700pF, 10%, 100V	CK05BX472K	81349
C11		Not Used		
C12	34-28-222	Cap, 2200pF, 10%, 200V	CK06BX222K	81349
C38		Not Used		
R2	26-20-R68	Resistor, WW, 0.68 ohm, 5%, 2W	BWH-R68-5%	75042
R8	25-34-15K	Resistor, 15K, 1%, 1/8W	RN60D1502F	81349
R25	25-25-2000	Resistor, 2K, 5%, 1/4W	RC07GF202J	81349
R40		Select at test		
R44	25-25-220	Resistor, 220 ohm, 5%, 1/4W	RC07GF221J	81349
R45	25-9-101	Resistor, 100 ohm, 5%, 1W	RC32GF101J	81349
R49	25-9-101	Resistor, 100 ohm, 5%, 1W	RC32GF101J	81349
R61	25-25-51K	Resistor, 51K, 5%, 1/4W	RC07GF513J	81349
R129	25-34-115K	Resistor, 115K, 1%, 1/8W	C51153	14674
R130		Select at test		
R142		Not Used		

TABLE 6-6F. ASSEMBLY A2, TUNING AND BIAS SUPPLY (C138-109-28) MODEL 436A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		This is a partial list for components unique to Assembly A2, (C139-109-28). Refer to Master Parts List Table 6-6, for a complete listing.		
C7	34-27-472	Cap., 4700 pF, 10%, 100V	81349	CK05BX472K
C10	34-27-332	Cap., 3300 pF, 10%, 100V	81349	CK05BX332K
C11	34-27-302	Cap., 3300 pF, 10%, 100V	81349	CK05BX332K
C12	34-27-471	Cap., 470 pF, 10%, 100V	81349	CK05BX471K
C16	34-27-472	Cap., 4700 pF, 10%, 100V	81349	CK05BX332K
C29	34-27-682	Cap., 6800 pF, 10%, 100V	81349	CK05BX682K
C34		Not used		
C35	34-28-104	Cap., .01μF, 10%, 100V	81349	CK06BX104K
C36	31-90	Cap., Tantalum 2.2μF, 20%, 35V	34133	T362B225H035A3
C37	31-80	Cap., Tantalum, 10μF, 35V	34133	T362C106M035A3
C38		Select at test		
C39	34-27-68	Cap., 680 pF, 10%, 200V	81349	CK05BX330K
C40	34-27-103	Cap., .01μF, 10%, 200V	81349	CK05BX103K
CR13	12-266	Diode, Zener 30V	07688	IN5256
F1	52-1=¾	Fuse, ¾ Amp	00000	AGC¾AMP
F2	52-1-1	Fuse, 1 Amp	00000	AGC1AMP
R1	25-25-33	Resistor, 33 ohm, 5%, ¼W	81349	RC07GF330J
R2	26-30-1R2	Resistor, 1.2Ω, 1%, 3W	81349	RW79V1R20F
R3	25-25-2200	Resistor, 2.2K, 5%, ¼W	81349	RC07GF222J
R5		Not used		
R8		Select at test		
R17		Not used		
R22	26-30-2R75	Resistor, 2.75Ω, 1%, 3W	81349	RW79U2R75F
R23	25-20-470	Resistor, 470Ω, 5%, ¼W	81349	RC07GF471J
R25	25-25-3900	Resistor, 3.9K, 5%, ¼W	81349	RC97GF392J
R26	025-25-51K	Resistor, 51K, 5%, 1/4W	81349	RC07GF513J
R27	25-25-49K	Resistor, 49K, 5%, ¼W	81349	RC07GF493J
R31	20-203-202	Resistor, Variable, 2K	81349	3009P-1-202
R36	25-25-3000	Resistor, 3K, 5%, ¼W	81349	RC07GF302J
R40		Select at test		
R45	25-9-100	Resistor, 100Ω, 5%, 1W	81349	RC32GF101J
R49	25-9-100	Resistor, 100Ω, 5%, 1W	81349	RC32GF101J
R51	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R52	25-20-33R2K	Resistor, 33.2K, 1%, 1/8W	81349	RN60C3322F
R61		Select at test		
R85	25-8-6R8	Resistor, 6.8 ohm, 5%, ½W	81349	RC20GF6R8J
R86	25-20-150K	Resistor, 150K, 1%, 1/8W	81349	RN60C1503F
R88	25-20-169K	Resistor, 169K, 1%, 1/8W	81349	RN60C1693F
R104	20-203-201	Resistor, 200 ohm, Variable	32997	3009P-1-201
R107	25-20-178K	Resistor, 178K, 1%, 1/8W	81349	RN60C1783F
R129		Select at test		
R130		Select at test		
R134		Not used		
R135		Not used		
R136		Not used		
R137	25-25-1R8M	Resistor, 1.8M, 5%, ¼W	81349	RC07GF185J
R140		Not used		
R142	25-25-3000	Resistor, 3K, 5%, ¼W	81349	RC07GF302J
R143		Select at test		
R144		Not Used		

TABLE 6-6G. ASSEMBLY A2, TUNING AND BIAS SUPPLY (C139-109-19)
MODEL 438-1 SERIES

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		This is a partial list for components unique to Assembly A2, (C139-109-19). Refer to Master Parts List Table 6-6, for a complete listing.		
C7	34-27-472	Cap., 4700 pF, 10%, 100V	81349	CK05BX472K
C10*	34-27-332	Cap., 3300 pF, 10%, 100V	81349	CK05BX332K
C10	34-27-222	Cap., 2200 pF, 10%, 100V	81349	CK05BX222K
C11		Not Used		
C12	34-27-222	Cap., 2200pF, 10%, 100V	81349	CK05BX222K
C16*	34-27-472	Cap., 4300 pF, 10%, 100V	81349	CK05BX472K
C16	34-27-152	Cap., 1500 pF, 10%, 100V	81349	CK05BX152K
C29*	34-27-472	Cap., 4700 pF, 10%, 100V	81349	CK05BX472K
C29	34-27-470	Cap., 470 pF, 10%, 100V	81349	CK05BX470K
C34	34-27-330	Cap., 330 pF, 10%, 200V	81349	CK05BX330K
C35*		Not used		
C35	34-28-104	Cap., .01μF, 10%, 100V	81349	CK06BX104K
C36*		Not Used		
C36	31-80	Cap, Tantalum, 10μF, 35V	34133	T362C106M0J5A5
C37*		Not used		
C37	31-80	Cap., Tantalum, 10μF, 35V	34133	T362C106M0J5A5
C38		Select at test		
C39*		Not used		
C39	34-27-681	Cap., 680 pF, 10%, 200V	81349	CK05BX330K
C40*		Not used		
C40	34-27-103	Cap., .01μF, 10%, 200V	81349	CK05BX103K
CR13	12-196	Diode Zener 15V	07688	1N4744A
F1	52-1-¾	Fuse ¾ Amp	00000	AGC¾AMP
F2	52-1-¼	Fuse ¼ Amp	00000	AGC¼AMP
R1	25-25-33	Resistor, 33 ohm, 5%, ¼W	81349	RC07GF330J
R2*	26-20-R75	Resistor WW, 75Ω, 5%, 2W	81349	RW80UR75J
R2	26-30-1R78	Resistor, 1.78Ω, 1%, 3W	81349	RW79U1R78F
R3*	25-8-2400	Resistor, 2.4K, 5%, ½W	81349	RC20
R3	25-25-2200	Resistor, 2.2K, 5%, ¼W	81349	RC07GF222J
R5		Not used		
R8	25-20-15K	Resistor, 15K, 1%, 1/8W	81349	RN60C1502K
R17		Not used		
R22	26-67-8R66	Resistor, 8.66Ω,1%, 1W	81349	RW70V8R66
R23*	25-20-680	Resistor, 680Ω,5%, ¼W	81349	RC07GF691J
R23	25-20-470	Resistor, 470Ω,5%, ¼W	81349	RC07GF471J
R25	25-25-3300	Resistor, 3.3K, 5%, ¼W	81349	RC07GF332J
R26		Not Used		
R27	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R31	20-203-202	Resistor, Variable, 2K	32997	3009P-1-202
R36	25-25-5100	Resistor, 5.1K, 5%, ¼W	81349	RC07GF512J
R40	25-25-6800	Resistor, 6.8K, 5%, ¼W	81349	RC07GF082J
R45	25-9-47	Resistor, 47Ω,5%, 1W	81349	RC32GF470J
R49	25-9-47	Resistor, 47Ω,5%, 1W	81349	RC32GF470J
R51	25-25-150K	Resistor, 150K, 5%, ¼W	81349	RC07GF154J
R52	25-20-69R8K	Resistor, 69.8K, 1%, 1/8W	81349	RN60C0982F
R61*	25-25-330K	Resistor, 330K, 5%, ¼W	81349	RC07GF334J

*Rev F only

TABLE 6-6G. ASSEMBLY A2, TUNING AND BIAS SUPPLY (C139-109-19) (Cont.)
MODEL 438-1 SERIES

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R61	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R85	25-8-33	Resistor, 33Ω,5%, ½W	81349	RC20GF330J
R86	25-20-178K	Resistor, 178K, .1%, 1/8W	81349	RN60C1783F
R88	25-20-499K	Resistor, 681K, 1%, 1/8W	81349	RN60C6813F
R104	20-203-501	Resistor, Variable, 500Ω	32997	3009P-1-501
R107	25-20-221K	Resistor, 221K, 1%, 1/8W	81349	RN60C2213F
R129*	25-20-348K	Resistor, 348K, 1%, 1/8W	81349	RN60C3483F
R129		Select at test		
R130*	25-20-348K	Resistor, 348K, 1%, 1/8W	81349	RN60C3483F
R130		Select at test		
R134	25-17-1R27M	Resistor, 1.27M, 1%, 1/8W	81349	RN6001274F
R135	25-28-75K	Resistor, 75K, 1%, 1/8W	81349	RN60E7502F
R136*		Select at test		
R136	20-189-500	Resistor, Variable, 500Ω		
R137*	25-25-1.8M	Resistor 1.8M, 5%, ¼W		RC07GF185J
R137	25-25-4R7M	Resistor 4.7M, 5%, ¼W		RC07GF185J
R140		Not used		
R142		Not used		
R143		Select at test		
R144	025-25-15K	Resistor, 15K, 5%, 1/4W	81349	RC07GF153J

TABLE 6-6H. ASSEMBLY A2, TUNING AND BIAS SUPPLY (D139-109-29) MODEL 442A, PARTS LIST

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		This is a partial list for components unique to Assembly A2, (D139-109-21). Refer to Master Parts List Table 6-6, for a complete listing.		
C7	34-27-472	Cap., 4700 pF, 10%, 100V	81349	CK05BX472K
C10	34-27-332	Cap., 3300pF, 10% 100V	81349	CK05BX332K
C11	34-28-223	Cap., .022pF, 10%, 100V	81349	CK06BX223K
C12	34-27-222	Cap., 2200 pF, 10%, 100V	81349	CK05BX222K
C16	34-27-222	Cap., 2200 pF, 10%, 100V	81349	CK05BX222K
C29	34-27-470	Cap., 470 pF, 10%, 100V	81349	CK05BX470K
C34	34-27-330	Cap., 330 pF, 10%, 200V	81349	CK05BX330K
C35*		Not used		
C35	34-28-104	Cap., .01μF, 10%, 100V	81349	CK06BX104K
C36*		Not used		
C36	31-80	Cap., Tantalum, 10μF, 35V	34133	T362C106MOJ5A5
C37*		Not used		
C37	31-80	Cap., Tantalum, 10μF, 35V	34133	T362C106MOJ5A5
C38		Select at test		
C39*		Not used		
C39	34-27-681	Cap., 680 pF, 10%, 200V	81349	CK05BX330K
C40*		Not used		
C40	34-27-103	Cap., .01μF, 10%, 200V	81349	CK05BX103K
CR13	12-196	Diode Zener 15V	07688	1N4744A
F1	52-1-¾	Fuse ¾ Amp	00000	AGC¾AMP
F2	52-1-¼	Fuse ¼ Amp	00000	AGC¼AMP
R1	25-25-33	Resistor, 33 ohm, 5%, ¼W	81349	RC07GF330J
R2*	26-20-R75	Resistor WW, .75Ω, 5%, 2W	81349	RW0UR75J
R2	26-30-1R78	Resistor, 1.78Ω, 1%, 3W	81349	RW78U1R78F
R3*	25-25-1800	Resistor, 1.8K, 5%, ¼W	81349	RC07GF182J
R3	25-25-3200	Resistor, 2.2K, 5%, ¼W	81349	RC07GF222J
R5		Not used		
R8		Select at test		
R17	26, 42, 220	Resistor, WW, 220Ω, 3%, 3W	31349	RS29201± 3%
R22	26-67-8R66	Resistor, 8.66Ω, 1%, 1W	81349	RW70U8R66
R23*	25-20-680	Resistor, 680Ω 5%, ¼W	81349	RC07GF631J
R23	25-20-470	Resistor 470Ω, 5%, ¼W	81349	RC07GF471J
R25	25-25-3300	Resistor, 3.3K, 5%, ¼W	81349	
R26	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R27	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R31	20-203-202	Resistor, Variable, 2K	32997	3009P-1-202
R36	25-25-5100	Resistor, 5.1K, 5%, ¼W	81349	RC07GF512J
R40	25-25-12K	Resistor, 12K, 5%, ¼W	81349	RC07GF123J
R45	25-9-100	Resistor, 100Ω,5%, 1W	81349	RC32GF101J
R49	25-9-100	Resistor, 100Ω,5%, 1W	81349	RC32GF101J
R51	25-25-51K	Resistor, 51K, 5%, ¼W	81349	RC07GF513J
R52	25-20-69R8K	Resistor, 69.8K, 1%, 1/8W	81349	RN60C0982F
R61	25-25-100K	Resistor, 100K, 5%, ¼W	81349	RC07GF104J
R85	25-8-33	Resistor, 33Ω,5%, ½W	81349	RC20GF330J
R86	25-20-178K	Resistor, 178K, 1%, 1/8W	81349	RN60C178JF
R88	25-20-499K	Resistor, 681K, 1%, 1/8W	81349	RN60C6813F

*Ref F Only

TABLE 6-6H. ASSEMBLY A2, TUNING AND BIAS SUPPLY (D139-109-29) (Cont.)
MODEL 442A, PARTS LIST

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R104	20-203-501	Resistor, Variable, 500Ω	32997	3009P-1-501
R107	25-20-221K	Resistor, 221K, 1%, 1/8W	81349	RN60C2213F
R129*	25-20-348K	Resistor, 348K, 1%, 1/8W	81349	RN60C3483F
R129		Select at test		
R130*	25-20-348K	Resistor, 348K, 1%, 1/8W	81349	RN60C3483F
R130		Select at test		
R134	25-17-1R27M	Resistor, 1.27M, 1%, 1/8W	81349	RN60D1274F
R135	25-28-75K	Resistor, 75K, 1%, 1/8W	81349	RN60E7502F
R136*		Select at test		
R136	20-189-500	Resistor, Variable, 500Ω		
R137*	25-25-1.8M	Resistor, 1.8M, 5%, ¼W	81349	RC07GF185J
R137	25-25-4R7M	Resistor, 4.7M, 5%, ¼W	81349	RC07GF185J
R140		Not used		
R142		Not used		
R143		Select at test		
R144		Not Used		

*Rev F only

TABLE 6-6I. ASSEMBLY A2, TUNING AND BIAS SUPPLY (D139-109-26) MODEL 444A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		This is a partial list for components unique to Assembly A2, (C139-109-26). Refer to Master Parts List Table 6-6, for a complete listing.		
A2	C139-109-26	Tuning and Bias Supply		
C1	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
C5	31-80	Cap, 10μF, 35V	81433	T362C106M035
C12	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
C14	34-27-472	Cap, 4700pF, 10%, 200V	81349	CK06BX472K
C15	34-28-R047	Cap, .047μF, 10%, 50V	81349	CK05BX473K
C16	34-27-472	Cap, 4700pF, 10%, 200V	81349	CK06BX472K
C29	34-31-6800	Cap, 6800pF, 10%, 100V	81349	CK05BX682K
C36		Not Used		
C37		Not Used		
F1	52-1-1.5	Fuse, 1.5 amp	00000	AGC 1.5
F2	52-1-1.5	Fuse, 1.5 amp	00000	AGC 1.5
K1	47-30	Relay, Reed	70109	ARA1 130062
Q19	12-140	Transistor	07688	2N4403
R1	25-25-68	Resistor, 68 ohm, 5%, ½W	81349	RC07GF680J
R2	26-20-1	Resistor, 1 ohm, 5%, 2W	81349	RC42GF010J
R3	25-9-1200	Resistor, 1.2K, 5%, ½W	81349	RC20GF122J
R8	25-20-*	Select at Test	81349	RN60C
R10	25-20-*	Select at Test	81349	RN60C
R17		Not Used		
R22	26-30-2R43	Resistor, 2.43 ohm, 1%, 3W	81349	RW79
R25	25-25-3900	Resistor, 3.9K, 5%, ¼W	81349	RC07GF392J
R26	025-25-51K	Resistor, 51K, 5%, 1/4W	81349	RC07GF513J
R30	25-28-*	Resistor, Select at Test		
R31	20-189-2K	Resistor, Variable 2K	81349	89P
R40	25-25-12K	Resistor, 12K, 5%, ¼W	81349	RC07GF123J
R42	25-25-200	Resistor, 200 ohm, 5%, ¼W	81349	RC07GF201J
R45	25-9-47	Resistor, 47 ohm, 5%, ¼W	81349	RC32GF470J
R49	25-9-47	Resistor, 47 ohm, 5%, ¼W	81349	RC32GF470J
R51	25-25-100K	Resistor, 100K, 5%, ¼W	81349	RC07GF104J
R52	25-20-34R8K	Resistor, 34.8K ohm, 1%, 1/8W	81349	RN60C3482F
R61	25-25-560K	Resistor, 560K, 5%, ¼W	81349	RC07GF564J
R85	25-8-6R8	Resistor, 6.8 ohm, 5%, ½W	81349	RC20GF6R8J
R86	25-20-150K	Resistor, 150K, 1%, 1/8W	81349	RN60C1503F
R88	25-20-169	Resistor, 169K, 1%, 1/8W	81349	RN60C1693F
R104	20-180-500	Resistor, Variable 500 ohm	81349	89P
R105	25-28-*	Select at Test	81349	RN60E*
R107	25-20-150K	Resistor, 150K, 1%, 1/8W	81349	RN60C1503F
R117	25-25-68K	Resistor, 68K, 5%, ¼W	81349	RC07GF221J
R129	25-20-178K	Resistor, 178K, 1%, 1/8W	81349	RN60C1783F
R130	25-20-178K	Resistor, 178K, 1%, 1/8W	81349	RN60C1783F
R134		Not Used		
R135		Not Used		
R136		Not Used		
R139	25-20-*	Resistor, Select at Test	81349	RN60C*
R144		Not Used		

*Value is to be determined at test

TABLE 6-7. ASSEMBLY A3, AUX TERMINATION BD (B139-814) PARTS LIST, ALL MODELS EXCEPT 438A, 435A/43

REF. DES.	WEINSCHEL PART NO.	DESCRIPTION	MFG. PART NO.	MFG. CODE
E1	74-474	Terminal, Solder	4531B-5.04	15849
E2	74-474	Terminal, Solder	4531B-5.04	15849
E3	74-474	Terminal, Solder	4531B-5.04	15849
E4	74-474	Terminal, Solder	4531B-5.04	15849
R1*	26-30-147	Resistor, WW, 147, 3W, 1%	RS-2B-147-1	91637

*Used on Model 433AH only.

TABLE 6-8. ASSEMBLY A3, HEATER BOARD (C139-476-1) PARTS LIST, MODEL 438A ONLY

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A3	C139-476-1	Heater Board Assembly		
C1	31-80	Cap, Tant, 10μF, 20%, 35V	31433	T362C106M035AS
CR1	12-225	Diode	07688	1N4749
CR2	12-290	Diode	07688	1N5313
Q1	12-208	Transistor, PNP	04713	MKE105
R2	25-9-56	Resistor, 56Ω, 5%, 1W	81349	RC32GF560J

TABLE 6-9. ASSEMBLY A4, SYMMETRICAL SWEEP SWITCH (B139-199) PARTS LIST, MODELS 431A, 438A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	B139-199	Symmetrical Sweep Switch Assembly		
C1	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
R1	P/O S1			
R2	25-20-6980	Resistor, 6980 ohm, 1%, 1/8W	81349	RN60C6981F
R3	25-20-3480	Resistor, 3480 ohm, 1%, 1/8W	81349	RN60C3481F
R4	25-20-1400	Resistor, 1400 ohm, 1%, 1/8W	81349	RN60C1401F
R5	25-20-698	Resistor, 698 ohm, 1%, 1/8W	81349	RN60C6980F
R6	25-20-348	Resistor, 348 ohm, 1%, 1/8W	81349	RN60C3480F
R7	25-20-140	Resistor, 140 ohm, 1%, 1/8W	81349	RN60C1400F
R8	25-20-69R8	Resistor, 69.8 ohm, 1%, 1/8W	81349	RN60C69R8F
R9	25-20-34R8	Resistor, 34.8 ohm, 1%, 1/8W	81349	RN60C34R8F
R10	25-20-14	Resistor, 14.0 ohm, 1%, 1/8W	81349	RN60C14R0F
R11		Not Used		
R12	25-25-47K	Resistor, 47K ohm, 5%, ¼W	81349	RC07GF473J
S1	B56-72	Switch, Rotary/Pot	93459	B56-72

TABLE 6-10. ASSEMBLY A4, SYMMETRICAL SWEEP SWITCH (B139-200) PARTS LIST, MODEL 432A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	B139-200	Symmetrical Sweep Switch Assembly		
C1	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
R1	P/O S1			
R2	25-20-6980	Resistor, 6980 ohm, 1%, 1/8W	81349	RN60C6981F
R3	25-20-3480	Resistor, 3480 ohm, 1%, 1/8W	81349	RN60C3481F
R4	25-20-1740	Resistor, 1740 ohm, 1%, 1/8W	81349	RN60C1741F
R5	25-20-698	Resistor, 698 ohm, 1%, 1/8W	81349	RN60C6980F
R6	25-20-348	Resistor, 348 ohm, 1%, 1/8W	81349	RN60C3480F
R7	25-20-174	Resistor, 174 ohm, 1%, 1/8W	81349	RN60C1740F
R8	25-20-69R8	Resistor, 69.8 ohm, 1%, 1/8W	81349	RN60C69R8F
R9	25-20-34R8	Resistor, 34.8 ohm, 1%, 1/8W	81349	RN60C34R8F
R10	25-20-17R4	Resistor, 17.4 ohm, 1%, 1/8W	81349	RN60C17R4F
R11		Not Used		
R12	25-25-47K	Resistor, 47K ohm, 5%, ¼W	81349	RC07GF473J
S1	B56-72	Switch, Rotary/Pot	93459	B56-72

TABLE 6-11. ASSEMBLY A4, SYMMETRICAL SWEEP SWITCH (B139-788) PARTS LIST, MODEL 433A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	B139-788	Symmetrical Sweep Switch Assembly		
C1	34-27-220	Cap, 2200pF, 10%, 100V	81349	CK05RX222K
R1	P/O S1			
R2	25-20-6980	Resistor, 6980 ohm, 1%, 1/8W	81349	RN60C6981F
R3	25-20-3480	Resistor, 3480 ohm, 1%, 1/8W	81349	RN60C3481F
R4	25-20-1740	Resistor, 1740 ohm, 1%, 1/8W	81349	RN60C1741F
R5	25-20-866	Resistor, 866 ohm, 1%, 1/8W	81349	RN60C8660F
R6	25-20-348	Resistor, 348 ohm, 1%, 1/8W	81349	RN60C3480F
R7	25-20-174	Resistor, 174 ohm, 1%, 1/8W	81349	RN60C1740F
R8	25-20-86R6	Resistor, 86.6 ohm, 1% 1/8W	81349	RN60C81R6F
R9	25-20-34R8	Resistor, 34.8 ohm, 1%, 1/8W	81349	RN60C34R8F
R10	25-20-17R4	Resistor, 17.4 ohm, 1%, 1/8W	81349	RN60C17R4F
R11		Not used		
R12	25-25-47K	Resistor, 47K ohm, 5%, 1/4W	81349	RC076F473J
S1	B56-72	Switch, Rotary/Pot	93459	B56-72

TABLE 6-12. ASSEMBLY A4, SYMMETRICAL SWEEP SWITCH (B139-789) PARTS LIST, MODEL 434A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	B139-789	Symmetrical Sweep Switch Assembly		
C1	34-27-220	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
R1	P/O S1			
R2	25-20-6340	Resistor, 6340 ohm, 1%, 1/8W	81349	RN60C6341F
R3	25-20-3160	Resistor, 3160 ohm, 1%, 1/8W	81349	RN60C3161F
R4	25-20-1580	Resistor, 1580 ohm, 1%, 1/8W	81349	RN60C1581F
R5	25-20-806	Resistor, 806 ohm, 1%, 1/8W	81349	RN60C8060F
R6	25-20-316	Resistor, 316 ohm, 1%, 1/8W	81349	RN60C3160F
R7	25-20-158	Resistor, 158 ohm, 1%, 1/8W	81349	RN60C1580F
R8	25-20-80R6	Resistor, 80.6 ohm, 1%, 1/8W	81349	RN60C80R6F
R9	25-20-31R6	Resistor, 31.6 ohm, 1%, 1/8W	81349	RN60C31R6F
R10	25-20-15R8	Resistor, 15.8 ohm, 1%, 1/8W	81349	RN60C15R8F
R11		Not used		
R12	25-25-47K	Resistor, 47K ohm, 5%, 1/4W	81349	RC076F473J
S1	B56-72	Switch, Rotary/Pot	93459	B56-72

TABLE 6-13. ASSEMBLY A4, SYMMETRICAL SWEEP SWITCH (B139-202) PARTS LIST, MODEL 434A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	B139-202	Symmetrical Sweep Switch Assembly		
C1	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
R1	P/O S1			
R2	25-20-6190	Resistor, 6190 ohm, 1%, 1/8W	81349	RN60C6191F
R3	25-20-2490	Resistor, 2490 ohm, 1%, 1/8W	81349	RN60C2491F
R4	25-20-1270	Resistor, 1270 ohm, 1%, 1/8W	81349	RN60C1271F
R5	25-20-619	Resistor, 619 ohm, 1%, 1/8W	81349	RN60C6190F
R6	25-20-249	Resistor, 249 ohm, 1%, 1/8W	81349	RN60C6190F
R7	25-20-127	Resistor, 127 ohm, 1%, 1/8W	81349	RN60C1270F
R8	25-20-61R9	Resistor, 61.9 ohm, 1%, 1/8W	81349	RN60C61R9F
R9	25-20-24R9	Resistor, 24.9 ohm, 1%, 1/8W	81349	RN60C24R9F
R10	25-20-12R7	Resistor, 12.7 ohm, 1%, 1/8W	81349	RN60C12R7F
R11		Not used		
R12	25-25-47K	Resistor, 47K ohm, 5%, 1/4W	81349	RC076F473J
S1	B56-72	Switch, Rotary/Pot	93459	B56-72

TABLE 6-14. ASSEMBLY A4, SYMMETRICAL SWEEP SWITCH (SK3265) PARTS LIST, MODEL 436A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	SK3265	Symmetrical Sweep Switch		
C1	34-27-222	Cap., 2200pF, 10%, 100V	81349	CK05BX222K
R1	P/O S1			
R2	25-20-4120	Resistor, 4.12K, 1%, 1/8W	81349	RN60C4120F
R3*	25-20-1620	Resistor, 1.62K, 1%, 1/8W	81349	RN60C1621F
R4	25-20-8250	Resistor, 825Ω, 1%, 1/8W	81349	RN60C8250F
R5	25-20-412	Resistor, 412Ω, 1%, 1/8W	81349	RN60C4120F
R6*	25-20-162	Resistor, 162Ω, 1%, 1/8W	81349	RN60C1620F
R7	25-20-8752	Resistor, 87.5Ω, 1%, 1/8W	81349	RN60C8752F
R8	25-20-41R2	Resistor, 41.2Ω, 1%, 1/8W	81349	RN60C41R2F
R9	25-17-16R5	Resistor, 16.5Ω, 1%, 1/8W	81349	RN60D1652F
R10*	25-20-8R66	Resistor, 8.66Ω, 1%, 1/8W	81349	RN60D8661F
R11		Not used		
R12	25-25-47K	Resistor, 47K, 5%, 1/4W	81349	25-25-47K
S1	B56-72	Switch, Rotary/Pot	93459	B56-72
*There may be parallel resistors for these reference designations. Refer to the list below for parallel resistor values.				
R3	25-20-1740	Resistor, 1.74K, 1%, 1/8W	81349	RN60C1740F
	25-20-3162	Resistor, 31.6K, 1%, 1/8W	81349	RN60C3162F
R6	25-20-196	Resistor, 196Ω, 1%, 1/8W	81349	RN60C1960F
	25-20-1020	Resistor, 1.02K, 1%, 1/8W	81349	RN60C1020F
R9	25-20-17R4	Resistor, 17.4Ω, 1%, 1/8W	81349	RN60C17R4F
	25-20-316	Resistor, 316Ω, 1%, 1/8W	81349	RN60C3160F
R10	25-20-11R3	Resistor, 11.3Ω, 1%, 1/8W	81349	RN60C11R30F
	25-20-30R9	Resistor, 30.9Ω, 1%, 1/8W	81349	RN60C30R9F

TABLE 6-15. ASSEMBLY A4, SYMMETRICAL SWEEP SWITCH (B139-275) PARTS LIST, MODEL 442A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	B139-275	Assembly, Symmetrical Sweep Switch		
C1	34-28-222	Cap, 2200pF, 10%, 100V		CK06BX222K
R1	P/O S1			
R2	25-20-6980	Resistor, 6980 ohm, 1%, 1/8W	81349	RN60C6981F
R3	25-20-2800	Resistor, 2800 ohm, 1%, 1/8W	81349	RN60C2801F
R4	25-20-1400	Resistor, 1400 ohm, 1%, 1/8W	81349	RN60C1401F
R5	25-20-698	Resistor, 698 ohm, 1%, 1/8W	81349	RN60C6980F
R6	25-20-280	Resistor, 280 ohm, 1%, 1/8W	81349	RN60C2800F
R6	25-20-140	Resistor, 140 ohm, 1%, 1/8W	81349	RN60C1400F
R8	25-20-69R8	Resistor, 69.8 ohm, 1%, 1/8W	81349	RN60C69R8F
R9	25-20-28R0	Resistor, 28.0 ohm, 1%, 1/8W	81349	RN60C28R0F
R10	25-20-14R0	Resistor, 14.0 ohm, 1%, 1/8W	81349	RN60C14R0F
R11		Not Used		
R12	25-25-47K	Resistor, 47K, 5%, 1/4W		RC07GF473J
S1	B56-72	Switch, Rotary/Pot	93459	B56-72

TABLE 6-16. ASSEMBLY A4, SYMMETRICAL SWEEP SWITCH (SK2609) PARTS LIST, MODEL 444A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	SK2609	Assembly, Symmetrical Sweep Switch		
C1	34-28-222	Cap, 2200pF, 10%, 100V	81349	CK06BX222K
R1	P/O S1			
R2	25-20-6980	Resistor, 6980 ohm, 1%, 1/8W	81349	RN60C6981F
R3	25-20-2800	Resistor, 2800 ohm, 1%, 1/8W	81349	RN60C2801F
R4	25-20-1400	Resistor, 1400Ω, 1%, 1/8W	81349	RN60C1401F
R5	25-20-698	Resistor, 698Ω, 1%, 1/8W	81349	RN60C6980F
R6	25-20-280	Resistor, 280Ω, 1%, 1/8W	81349	RN60C2800F
R7	25-20-140	Resistor, 140Ω, 1%, 1/8W	81349	RN60C1400F
R8	25-20-69R8	Resistor, 69.8Ω, 1%, 1/8W	81349	RN60C69R8F
R9	20-20-28	Resistor, 28Ω, 1%, 1/8W	81349	RN60C280F
R10	25-20-14	Resistor, 14Ω, 1%, 1/8W	81349	RN60C14R0F
R11		Not Used		
R12	25-25-47K	Resistor, 47K, 5%, 1/4W	81349	RC076F473J
S1	B56-72	Switch, Rotary/Pot	93459	B56-72

TABLE 6-17. ASSEMBLY A5, CONTROL LOGIC (C139-459) PARTS LIST, MODEL 438A

REFERENCE DESIGNATION	℄ PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5	C139-459	Circuit Board Assembly Control Logic		
C1		Not used		
C2	34-28-104	Cap, 0.1μF, 10%, 50V	81349	CK06BX104K
C3	34-27-220	Cap, 22pF, 10%, 200V	81349	CK05BX220K
C4	34-27-151	Cap, 150pF, 10%, 200V	81349	CK05BX151K
C5		Not used		
C6	34-27-102	Cap, 0.001μF, 10%, 200V	81349	CK05BX102K
C7	34-27-102	Cap, 0.001μF, 10%, 200V	81349	CK05BX102K
C8	34-28-103	Cap, 0.01μF, 10%, 100V	81349	CK06BX103K
C9	34-27-471	Cap, 470pF, 10%, 100V	81349	CK05BX471K
C10	34-27-471	Cap, 470pF, 10%, 100V	81349	CK05BX471K
C11	34-27-471	Cap, 470pF, 10%, 100V	81349	CK05BX471K
C12	34-27-471	Cap, 470pF, 10%, 100V	81349	CK05BX471K
C13	34-27-222	Cap, 0.0022μF, 10%, 100V	81349	CK06BX222K
C14	34-28-104	Cap, 0.1μF, 10%, 50V	81349	CK06BX104K
C15	34-28-104	Cap, 0.1μF, 10%, 50V	81349	CK06BX104K
C16	34-28-101	Cap, 100pF, 10%, 200V (Not used in serial No. 1906 and up)	81349	CK05BX101K
C17		Not used		
C18	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK06BX222K
C19	34-27-560	Cap, 56pF, 10%, 100V	81349	CK05BX560K
C20	34-28-104	Cap, 0.1μF, 10%, 50V	81349	CK06BX104K
C21	34-27-101	Cap, 100pF, 10%, 200V	81349	CK05BX101K
C22	34-28-104	Cap, 0.1μF, 10%, 50V	81349	CK06BX104K
C23	34-27-100	Cap, 10pF, 10%, 200V	81349	CK06BX100K
C24	34-27-102	Cap, .001μF, 10%, 200V (Not used before Rev E)	81349	CK05BX102K
C25		Not used		
C26	34-27-221	Cap, 220pF, 10%, 200V (Not used before Rev E)	81349	CK06BX221K
CR1	12-51	Diode	07688	1N3064
CR2	12-51	Diode	07688	1N3064
CR3	12-51	Diode	07688	1N3064
CR4	12-51	Diode	07688	1N3064
CR5	12-51	Diode	07688	1N3064
CR6	12-51	Diode	07688	1N3064
CR7	12-51	Diode	07688	1N3064
CR8	12-51	Diode	07688	1N3064
CR9	12-51	Diode	07688	1N3064
CR10	12-51	Diode	07688	1N3064
CR11	12-51	Diode	07688	1N3064
CR12	12-51	Diode	07688	1N3064
CR13	12-51	Diode	07688	1N3064
CR14	12-51	Diode	07688	1N3064
CR15	12-51	Diode	07688	1N3064
CR16	12-51	Diode	07688	1N3064
CR17	12-51	Diode	07688	1N3064
CR18	12-51	Diode	07688	1N3064
CR19	12-51	Diode	07688	1N3064
CR20	12-51	Diode	07688	1N3064
CR21	12-51	Diode	07688	1N3064

TABLE 6-17. ASSEMBLY A5, CONTROL LOGIC (C139-459) PARTS LIST, MODEL 438A (Cont'd)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
U1	12-170	Circuit, Integrated	04713	MC830P
U2	12-172	Transistor Array	02735	CA3046
U3	12-250	Circuit Integrated	02735	CD4016AE
U4	12-250	Circuit, Integrated	02735	CD4016AE
U5	12-165	Amplifier Operational	27014	LM301AH
U6	12-192	Circuit Integrated	04713	MC1458P
U7	12-165	Amplifier Operational	27014	LM301AH
U8	12-192	Circuit, Integrated	04713	MC1458P
K1	47-29	Relay, Reed	12300	JRM1049
Q1	12-140	Transistor, PNP	07688	2N4403
Q2	12-140	Transistor, PNP	07688	2N4403
Q3	12-140	Transistor, PNP	07688	2N4403
Q4	12-139	Transistor, NPN	07688	2N4401
Q5	12-139	Transistor, NPN	07688	2N4401
Q6	12-140	Transistor, PNP	07688	2N4403
Q7	12-140	Transistor, PNP	07688	2N4403
Q8	12-139	Transistor, NPN	07688	2N4401
Q9	12-139	Transistor, NPN	07688	2N4401
Q10	12-139	Transistor, NPN	07688	2N4401
Q11	12-139	Transistor, NPN	07688	2N4401
Q12	12-139	Transistor, NPN	07688	2N4401
Q13	12-140	Transistor, PNP	07688	2N4403
Q14	12-140	Transistor, PNP	07688	2N4403
Q15	12-140	Transistor, PNP	07688	2N4403
Q16	12-139	Transistor, NPN	07688	2N4401
Q17	12-139	Transistor, NPN	07688	2N4401
Q18	12-139	Transistor, NPN	07688	2N4401
Q19	12-139	Transistor, NPN	07688	2N4401
Q20	12-140	Transistor, PNP	07688	2N4403
Q21	12-140	Transistor, PNP	07688	2N4403
Q22	12-140	Transistor, PNP	07688	2N4403
Q23	12-140	Transistor, PNP	07688	2N4403
Q24	12-139	Transistor, NPN	07688	2N4401
Q25	12-140	Transistor, PNP	07688	2N4403
Q26	12-140	Transistor, PNP	07688	2N4403
Q27	12-139	Transistor, NPN	07688	2N4401
Q28	12-139	Transistor, NPN	07688	2N4401
Q19	12-139	Transistor, NPN	07688	2N4401
Q30	12-140	Transistor, PNP	07688	2N4403
Q31	12-139	Transistor, NPN	07688	2N4401
Q32	12-140	Transistor, PNP	07688	2N4403
Q33	12-139	Transistor, NPN	07688	2N4401
Q34	12-140	Transistor, PNP	07688	2N4403
Q35	12-139	Transistor, NPN	07688	2N4401
Q36	12-139	Transistor, NPN	07688	2N4401
Q37	12-139	Transistor, NPN	07688	2N4401
Q38	12-140	Transistor, PNP	07688	2N4403

TABLE 6-17. ASSEMBLY A5, CONTROL LOGIC (C139-459) PARTS LIST, MODEL 438A (Cont'd)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
Q39	12-140	Transistor, PNP	07688	2N4403
Q40	12-139	Transistor, NPN (Used before Rev E)	07688	2N4401
Q40	12-222	Transistor, NPN (Used on Rev E and up)	07688	2N4045
Q41	12-139	Transistor, NPN (Not used on Rev E and up)	07688	2N4401
Q42	12-140	Transistor, PNP	07688	2N4403
Q43	12-139	Transistor, NPN	07688	2N4401
Q44	12-140	Transistor, PNP	07688	2N4403
R1	25-25-6800	Resistor, 6.8K ohm, 5%, ¼W	81349	RC07GF682J
R2	25-25-6800	Resistor, 6.8K ohm, 5%, ¼W	81349	RC07GF682J
R3	25-25-1500	Resistor, 1.5K ohm, 50%, ¼W	81349	RC07GF152J
R4	25-25-470	Resistor, 470 ohm, 5%, ¼W	81349	RC07GF471J
R5	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R6	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R7	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R8	25-25-15K	Resistor, 15K, 5%, ¼W	81349	RC07GF153J
R9	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R10	25-25-150	Resistor, 150 ohm, 5%, ¼W	81349	RC07GF151J
R11	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R12	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R13	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
*R14	25-25-150	Resistor, 150 ohm, 5%, ¼W	81349	RC07GF151J
R15	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R16	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R17	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R18	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R19	25-20-*	Resistor, TBD, 1%, 1/8W	81349	RN60C
R20	25-20-*	Resistor, TBD, 1%, 1/8W (Before Ser #1906)	81349	RN60C
R20	25-20-4120	Resistor 4.12K, 1%, 1/8W (Ser #1906 and up)	81349	RN60C4120F
R21	25-25-1000	Resistor, 1K, 5%, ¼W	81349	RC07GF102J
R22	25-25-1800	Resistor, 1.8K, 5%, ¼W	81349	RC07GF182J
R23	25-25-100K	Resistor, 100K, 5%, ¼W	81349	RC07GF104J
R24	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R25	25-8-680	Resistor, 680 ohm, 5%, ½W	81349	RC20GF681J
R26	25-8-680	Resistor, 680 ohm, 5%, ½W	81349	RC20GF681J
R27	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R28	25-25-470	Resistor, 470 ohm, 5%, ¼W	81349	RC07GF471J
R29	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R30	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R31	25-8-680	Resistor, 680 ohm, 5%, ½W	81349	RC20GF681J
R32	25-8-680	Resistor, 680 ohm, 5%, ½W	81349	RC20GF681J
R33	25-20-8R25K	Resistor, 8.25K, 1%, 1/8W	81349	RN60C8251F
R34	25-25-1K	Resistor, 1K ohm, 5%, ¼W	81349	RC07GF102J
R35	25-25-68K	Resistor, 68K, 5%, ¼W	81349	RC07GF683J
R36	25-25-1500	Resistor, 1.5K ohm, 5%, ¼W	81349	RC07GF152J
R37	25-25-470	Resistor, 470 ohm, 5%, ¼W	81349	RC07GF471J
R38		Not Used		
R39	25-25-12K	Resistor 12K, 5%, ¼W	81349	RC07GF123J
R40		Not Used		
R41	25-20-1R47K	Resistor, 1.47K, 1%, 1/8W	81349	RN60C1471F
R42	25-25-1K	Resistor, 1K ohm, 5%, ¼W	81349	RC07GF102J

*Nominal value only; actual value selected at test.

TABLE 6-17. ASSEMBLY A5, CONTROL LOGIC (C139-459) PARTS LIST, MODEL 438A (Cont'd)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R43	25-25-560	Resistor, 560 ohm, 5%, ¼W	81349	RC07GF561J
R44	25-25-100	Resistor, 100 ohm, 5%, ¼W	81349	RC07GF101J
R45	25-8-220	Resistor, 220 ohm, 5%, ½W	81349	RC10GF221J
R46	25-20-10K	Resistor, 10K, 1%, 1/8W	81349	RN60C1002F
R47	20-195-1K	Resistor, Variable, 1K ohm	73138	89P
R48	25-20-10K	Resistor, 10K, 1%, 1/8W	81349	RN60C1002F
R49	25-20-10K	Resistor, 10K, 1%, 1/8W	81349	RN60C1002F
R50	25-25-6800	Resistor, 6800 ohm, 5%, ¼W	81349	RC07GF682J
R51	25-20-10K	Resistor, 10K, 1%, 1/8W	81349	RN60C1002F
R52	25-25-33K	Resistor, 33K, 5%, ¼W	81349	RC07GF333J
R53	25-25-68	Resistor, 68 ohm, 5%, ¼W	81349	RC07GF680J
R54	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R55	25-25-1000	Resistor, 1K ohm, 5%, ¼W	81349	RC07GF102J
R56	25-95-10K	Resistor, 10K, 5%, 3W	81349	RW79U1002J
R57	25-25-1000	Resistor, 1K ohm, 5%, ¼W	81349	RC07GF102J
R58	26-95-10K	Resistor, 10K, 5%, 3W	81349	RW79U1002J
R59	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R60	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R61	25-20-10K	Resistor, 10K, 1%, 1/8W	81349	RN60C1002F
R62	20-195-501	Pot Trim 500, 10%, 1/2W	80294	3299W-1-501
R63	25-20-15K	Resistor, 15K, 1%, 1/8W	81349	RN60C1502F
R64	26-95-20K	Resistor, 20K, 5%, 3W	81349	RW79U2002J
R65	25-25-4700	Resistor, 4.7 ohm, 5%, ¼W	81349	RC07GF472J
R66	25-20-28R7K	Resistor, 28.7K, 1%, 1/8W	81349	RN60C2872F
R67	20-195-2000	Resistor, Variable, 2K	73138	89P
R68	26-95-20K	Resistor, 20K, 5%, 3W	81349	RW79U2002J
R69	26-95-10K	Resistor, 10K, 5%, 3W	81349	RW79U1002J
R70	25-25-3300	Resistor, 3.3K ohm, 5%, ¼W	81349	RC07GF332J
R71	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R72	25-20-287	Resistor, 287 ohm, 1%, 1/8W	81349	RN60C2870F
R73	25-20-10K	Resistor, 10K, 1%, 1/8W	81349	RN60C1002F
R74	25-20-15K	Resistor, 15K, 1%, 1/8W	81349	RN60C1502F
R75	26-95-10K	Resistor, 10K, 5%, 3W	81349	RW79U1002J
R76	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R77	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R78	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R79	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R80	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R81	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R82	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R83	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R84	25-25-470	Resistor, 470 ohm, 5%, ¼W	81349	RC07GF471J
R85	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R86	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R87	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R88		Not Used		
R89		Not Used		
R90		Not Used		
R91		Not Used		
R92		Not Used		

TABLE 6-17. ASSEMBLY A5, CONTROL LOGIC (C139-459) PARTS LIST, MODEL 438A (Cont'd)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R93		Not Used		
R94		Not Used		
R95	25-20-20K	Resistor, 20K, 1%, 1/8W	81349	RN60C2002F
R96	25-20-20K	Resistor, 20K, 1%, 1/8W	81349	RN60C2002F
R97	25-20-15K	Resistor, 15K, 1%, 1/8W	81349	RN60C1502F
R98	25-25-330K	Resistor, 330K, 5%, ¼W	81349	RC07GF334J
R99	25-20-22R1K	Resistor, 22.1K, 1%, 1/8W	81349	RN60C2212F
R100	25-20-221K	Resistor, 221K, 1%, 1/8W	81349	RN60C2213F
R101	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R102	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R103	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R104	25-25-2200	Resistor, 2.2K ohm, 5%, ¼W	81349	RC07GF222J
R105	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R106	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R107	25-25-560	Resistor, 560 ohm, 5%, ¼W	81349	RC07GF561J
R108	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R109	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R110	25-25-15K	Resistor, 15K, 5%, ¼W	81349	RC07GF153J
R111	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R112	25-25-3300	Resistor, 3.3K ohm, 5%, ¼W	81349	RC07GF332J
R113	25-25-1000	Resistor, 1K ohm, 5%, ¼W	81349	RC07GF102J
R114	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R115	25-25-4700	Resistor, 4.7K ohm, 5%, ¼W	81349	RC07GF472J
R116	25-25-220	Resistor, 220 ohm, 5%, ¼W	81349	RC07GF221J
R117	25-25-100	Resistor, 100 ohm, 5%, ¼W	81349	RC07GF101J
R118	25-25-6800	Resistor, 6.8K ohm, 5%, ¼W	81349	RC07GF682J
R119	25-25-150	Resistor, 150 ohm, 5%, ¼W	81349	RC07GF151J
R120	25-25-3300	Resistor, 3.3K ohm, 5%, ¼W	81349	RC07GF332J
R121	25-25-15K	Resistor, 15K, 5%, ¼W	81349	RC07GF153J
R122	25-20-2R55K	Resistor, 2.55K, 1%, 1/8W	81349	RN60C2551F
R123	25-20-845	Resistor, 845 ohm, 1%, 1/8W	81349	RN60C8450F
R124	25-25-820	Resistor, 820 ohm, 5%, ¼W	81349	RC07GF821J
R125	25-25-820	Resistor, 820 ohm, 5%, ¼W	81349	RC07GF821J
R126	25-25-1000	Resistor, 1K ohm, 5%, ¼W	81349	RC07GF102J
R127	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R128	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R129		Not Used		
R130	25-25-5100	Resistor, 5.1K ohm, 5%, ¼W	81349	RC07GF512J
R131	25-25-3600	Resistor, 3.6K ohm, 5%, ¼W	81349	RC07GF362J
R132	25-25-12K	Resistor, 12K, 5%, ¼W	81349	RC07GF123J
R133	25-25-390	Resistor, 390 ohm, 5%, ¼W	81349	RC07GF391J
R134	25-25-2700	Resistor, 2.7K ohm, 5%, ¼W	81349	RC07GF272J
R135	25-25-1000	Resistor, 1K ohm, 5%, ¼W	81349	RC07GF102J
R136	25-25-1000	Resistor, 1K ohm, 5%, ¼W	81349	RC07GF102J
R137	25-25-560	Resistor, 560 ohm, 5%, ¼W	81349	RC07GF561J
R138	25-25-100	Resistor, 100 ohm, 5%, ¼W (Not used before ser. #1906)		
TP1	62-153	Pin, Receptacle	71279	460-2970-02-03-00
TP2	62-153	Pin, Receptacle	71279	460-2970-02-03-00
TP3	62-153	Pin, Receptacle	71279	460-2970-02-03-00

TABLE 6-18. ASSEMBLY A8, FIXED OSCILLATOR–FILTER ASSEMBLY PARTS LIST, MODEL 438A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R1	25-8-470	Resistor, 470Ω, ½W, 5%	81349	RC20GF471J
R2	25-20-464	Resistor, 464Ω, 1/8W, 1%	81349	RN60C4640F
R3	25-20-*	Resistor, select at test	81349	RN60-*
C1	34-28-104	Capacitor, 0.1μF, 50V, 10%	81349	CK06BX104K
Q1	12-201	Transistor, NPN	07688	2N5108
CR1-CR5	12-48	DIODE	07688	1N277

*Value to be determined

TABLE 6-19. ASSEMBLY A11, HEAT EXCHANGER (139-316-1) PARTS LIST, MODELS 434A, 436A, 444A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A11	139-316-1	Heat Exchanger Assembly		
R1	25-25-6R8K	Resistor, 6.8K, 5%, ¼W	81349	RC07GF68RJ
R2	25-25-6R8K	Resistor, 6.8K, 5%, ¼W	81349	RC07GF68RJ
R3	25-25-1K	Resistor, 1K, 5%, ¼W	81349	RC07GF102J
R4	25-25-1K	Resistor, 1K, 5%, ¼W	81349	RC07GF102J
R5	26-79-20	Resistor, 20Ω, 3W	01884	242E2005
CR1	12-71	Diode	07688	1N753
Q1	12-140	Transistor	07688	2N4403
Q2	12-186	Transistor	04713	MJE1102

TABLE 6-20. ASSEMBLY A11, HEAT EXCHANGER (139-316-2) PARTS LIST, MODELS 435A, 435A/4309A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A11	139-316-2	Heat Exchanger Assembly		
R1	25-25-6R8K	Resistor, 6.8K, 5%, ¼W	81349	RC07GF68RJ
R2	25-25-6R8K	Resistor, 6.8K, 5%, ¼W	81349	RC07GF68RJ
R3	25-25-1K	Resistor, 1K, 5%, ¼W	81349	RC07GF68RJ
R4	25-25-1K	Resistor, 1K, 5%, ¼W	81349	RC07GF68RJ
R5	26-79-20	Resistor, 20Ω, 3W	01884	242E2005
CR1	12-71	Diode	07688	1N753
Q1	12-140	Transistor	07688	2N4403
Q2	12-186	Transistor	04713	MJE1102

TABLE 6-21. ASSEMBLY A12, AUXILIARY BOARD (C139-559) PARTS LIST, ALL MODELS EXCEPT 438A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A12	C139-559	Auxiliary Board		
C1	34-28-104	Cap, .1μF, 10%, 100V	81349	CK06BX104K
C2	34-28-104	Cap, .1μF, 10%, 100V	81349	CK06BX104K
C3	34-28-104	Cap, .1μF, 10%, 100V	81349	CK06BX104K
C4	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
C5	34-28-104	Cap, .1μF, 10%, 100V	81349	CK06BX104K
C6	34-27-471	Cap, 470pF, 10%, 200V	81349	CK05BX471K
C7	34-27-471	Cap, 470pF, 10%, 200V	81349	CK05BX471K
C8	34-28-104	Cap, .1μF, 10%, 100V	81349	CK06BX104K
C9	34-28-104	Cap, .1μF, 10%, 100V	81349	CK06BX104K
C10	34-27-471	Cap, 470pF, 10%, 200V	81349	CK05BX471K
C11	34-27-471	Cap, 470pF, 10%, 200V	81349	CK05BX471K
C12	34-28-104	Cap, .1μF, 10%, 100V	81349	CK06BX104K
C13	34-28-104	Cap, .1μF, 10%, 100V	81349	CK06BX104K
C14	34-27-471	Cap, 470pF, 10%, 200V	81349	CK05BX471K
C15	34-27-222	Cap, 2200pF, 10%, 100V	81349	CK05BX222K
C16	34-28-104	Cap, 1μF, 10%, 50V	81349	CK05BX104K
C17	34-28-104	Cap, 1μF, 10%, 50V	81349	CK05BX104K
C18		Not Used		
C19		Not Used		
C20	31-80	Cap, tant, 10μF, 35V	31433	T362C106M035AS
C21	31-80	Cap, tant, 10μF, 35V	31433	T362C106M035
C22	34-28-104	Cap, .1μF, 10%, 100V	81349	CK06BX104K
C23	34-27-103	Cap, .01μF, 10%, 100V	81349	CK05BX103K
C24	34-27-100	Cap, 10pF, 10%, 200V	81349	CK05BX100K
C25	34-28-104	Cap, .1μF, 10%, 100V	81349	CK06BX104K
CR1	12-51	Diode, Signal	07688	1N3064
CR2	12-45	Diode, Signal (Same as CR1 in earlier units)	07688	1N270
CR3	12-45	Diode, Signal (Same as CR1 in earlier units)	07688	1N270
CR4	12-45	Diode, Signal	07688	1N270
CR5	12-290	Diode, Constant Current	07688	1N5313
CR6	12-51	Diode, Signal	07688	1N3064
CR7	12-51	Diode, Signal	07688	1N3064
CR8	12-225	Diode, Zener 24V	07688	1N4749A
CR9	12-51	Diode, Signal	07688	1N3064
CR10	12-51	Diode, Signal	07688	1N3064
CR11	12-71	Diode, Zener 6.2V	07688	1N753A
Q1	12-208	Transistor Power, PNP	04713	MJE2901
Q2	12-140	Transistor, PNP	07688	2N4403
Q3	12-140	Transistor, PNP	07688	2N4403
Q4	12-139	Transistor, NPN	07688	2N4401
Q5	12-208	Transistor, PNP	04713	MJE2901
Q6	12-139	Transistor, NPN	07688	2N4401
Q7	12-139	Transistor, NPN	07688	2N4401
Q8	12-140	Transistor, PNP	07688	2N4403
Q9	12-140	Transistor, PNP	07688	2N4403
Q10	12-139	Transistor, NPN	07688	2N4401
Q11	12-140	Transistor, PNP	07688	2N4403

TABLE 6-21. ASSEMBLY A12, AUXILIARY BOARD (C139-559) PARTS LIST, ALL MODELS EXCEPT 438A (Cont'd)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R1	25-20-15K	Resistor, 15K, 1%, 1/8W	81349	RN60C1502F
R2	25-20-4990	Resistor, 499K, 1%, 1/8W	81349	RN60C4991F
R3	25-25-3300	Resistor, 3.3K, 5%, ¼W	81349	RC07GF332J
R4	25-25-4700	Resistor, 4.7K, 5%, ¼W	81349	RC07GF472J
R5	25-25-220	Resistor, 220Ω, 5%, ¼W	81349	RC07GF221J
R6	25-10-51	Resistor, 51Ω, 5%, 2W	81349	RC42GF510J
R7	25-25-10	Resistor, 10Ω, 5%, ¼W	81349	RC07GF100J
R8	25-25-10	Resistor, 10Ω, 5%, ¼W	81349	RC07GF100J
R9	25-25-4700	Resistor, 4.7K, 5%, ¼W	81349	RC07GF472J
R10	25-8-51	Resistor, 51Ω, 5%, ½W (Earlier units)	81349	RC20GF510J
R10	25-8-1000	Resistor, 1K, 5%, ½W (Later units)	81349	RC20GF102J
R11	25-25-470	Resistor, 470Ω, 5%, ¼W	81349	RC07GF471J
R12	25-25-100K	Resistor, 100K, 5%, ¼W (Earlier units)	81349	RC07GF104J
R12	25-25-1000	Resistor, 1K, 5%, ¼W (Later units)	81349	RC07GF102J
R13	25-8-68	Resistor, 68Ω, 5%, ½W	81349	RC20GF680J
R14	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R15	25-20-33R2K	Resistor, 33.2K, 1%, 1/8W	81349	RN60C3322F
R16	25-20-31R6K	Resistor, 31.6K, 1%, 1/8W	81349	RN603162F
R17	25-20-31R6K	Resistor, 31.6K, 1%, 1/8W	81349	RN603162F
R18	25-20-76R8K	Resistor, 76.8K, 1%, 1/8W	81349	RN60C7682F
R19	25-20-33R2K	Resistor, 33.2K, 1%, 1/8W	81349	RN60C3322F
R20	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R22	25-9-56	Resistor, 56Ω, 5%, 1W	81349	RC32GF560J
R23	25-25-5100	Resistor, 5.1K, 5%, ¼W	81349	RC07GF512J
R24	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R25	25-25-12K	Resistor, 12K, 5%, ¼W	81349	RC07GF123J
R26	25-25-2700	Resistor, 2.7K, 5%, ¼W	81349	RC07GF272J
R27	25-25-3600	Resistor, 3.6K, 5%, ¼W	81349	RC07GF362J
R28	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R29	25-25-820	Resistor, 820Ω, 5%, ¼W	81349	RC07GF821J
R30	25-25-1000	Resistor, 1K, 5%, ¼W	81349	RC07GF102J
R31	25-25-390	Resistor, 390Ω, 5%, ¼W	81349	RC07GF391J
R32	25-25-560	Resistor, 560Ω, 5%, ¼W	81349	RC07GF561J
R33	25-25-1000	Resistor, 1K, 5%, ¼W	81349	RC07GF102J
R34	25-25-1000	Resistor, 1K, 5%, ¼W (Used with -B option only)	81349	RC07GF102J
R35	25-20-76R8K	Resistor, 76.8K, 1%, 1/8W	81349	RN60C7682F
R36	25-25-22K	Resistor, 22K, 5%, ¼W	81349	RC07GF223J
R37	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
U1	12-165	Operational Amplifier	18324	LM301AH
U2	15-02-8830	Dual Differential Line Driver		DM8830
U3	12-283	J Fet Operational Amplifier	18324	LF356H
L1-L6	74-647	Bead Ferrite	02114	
L7	41-34	RF Choke 2.2 uf	93459	

TABLE 6-22. ASSEMBLY A13, LINEARITY AND AUXILIARY CIRCUIT BOARD ASSEMBLY (B139-1032) PARTS LIST, MODEL 435A/4309A (Serial No. 1994 and up)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A13	B139-1032	Linearity and auxiliary board assembly		
C1	34-27-104	Cap., .1μF, 10%, 50V	81349	CK05BX104K
C2	34-27-104	Cap., .1μF, 10%, 50V	81349	CK05BV104K
CR1	12-51	Diode, General Purpose	07688	1N3064
CR2	12-51	Diode, General Purpose	07688	1N3064
R1	25-30-1002	Resistor, 10K, 1%, 50PPM/°c	81349	RN55C1002F
R3	25-25-4R7K	Resistor, 4.7K, 5%, 1/4 W	81349	RG07F472J
R4		Select at test		
R5	25-30-1502	Resistor, 15K, 1%, 50PPM/°c	81349	RN55C1502F
R6	25-25-4R7K	Resistor, 4.7K, 5%, 1/4W	81349	RG07F472J
R7	25-30-1002	Resistor, 10K, 1%, 50PPM/°c	81349	RN55C1002F
U1	12-283	1C, JFET Operational Amplifier	18324	LF356H
U2	12-283	1C, JFET Operational Amplifier	18324	LF356H

The above (Table 6-22) is applicable to A13 PC board C139-1033 Rev A and up.

TABLE 6-23. ASSEMBLY A14, SOLID STATE SWITCH ASSEMBLY (C139-10) PARTS LIST, MODEL 435A/4309A

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A14	C139-10	Solid State Switch Assembly		
C1		Not Used		
C2		Not Used		
C3		Not Used		
C4		Not Used		
C5	34-27-101	Cap, 100 pf, 10%, 200V	81349	CK05BX101K
C6	34-27-101	Cap, 100 pf, 10%, 200V	81349	CK05BX101K
CR1	12-51	Diode, Signal	07688	1N3064
CR2	12-51	Diode, Signal	07688	1N3064
CR3	12-51	Diode, Signal	07688	1N3064
CR4	12-51	Diode, Signal	07688	1N3064
CR5	12-51	Diode, Signal	07688	1N3064
CR6	12-99	Diode, Signal	07688	1N483B
CR7	12-51	Diode, Signal	07688	1N3064
CR8	12-51	Diode, Signal	07688	1N3064
CR9	12-51	Diode, Signal	07688	1N3064
CR10	12-51	Diode, Signal	07688	1N3064
CR11	12-45	Diode, Signal	07688	1N270
K1	47-35	Relay, Three Pole	71482	MRB3A05
K2	47-35	Relay, Three Pole	71482	MRB3A05
Q1	12-140	Transistor, PNP	07688	2N4403
Q2	12-185	Transistor Power, NPN	04713	MJE6044
Q3	12-139	Transistor, NPN	07688	2N4401
Q4	12-186	Transistor Power, PNP	04713	MJE6041
Q5	12-140	Transistor, PNP	07688	2N4403
Q6	12-139	Transistor, NPN	07688	2N4401
Q7	12-140	Transistor, PNP	07688	2N4403
Q8	12-139	Transistor, NPN	07688	2N4401
Q9	12-139	Transistor, NPN	07688	2N4401
Q10	12-210	Transistor, PNP	27014	MM4003
Q11	12-211	Transistor, NPN	27014	MM421
Q12	12-211	Transistor, NPN	27014	MM421
Q13		Not Used		
Q14		Not Used		
Q15		Not Used		
Q16	12-140	Transistor, PNP	07688	2N4403
Q17	12-209	Transistor Power, NPN	04713	MJE205
Q18	12-139	Transistor, NPN	07688	2N4401
Q19	12-208	Transistor Power, PNP	04713	MJE105
Q20	12-140	Transistor, PNP	07688	2N4403
Q21	12-139	Transistor, NPN	07688	2N4401
Q22	12-139	Transistor, NPN	07688	2N4401
R1	25-25-3300	Resistor, 3.3K, 5%, ¼W	81349	RC07GF332J
R2		Not Used		
R3	25-25-470	Resistor, 470Ω, 5%, ¼W	81349	RC07GF471J
R4	25-25-3300	Resistor, 3.3K, 5%, ¼W	81349	RC07GF332J

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
R5	25-25-470	Resistor, 470Ω, 5%, ¼W	81349	RC07GF471J
R6	25-8-560	Resistor, 560Ω, 5%, ½W	81349	RC20GF561J
R7	25-25-1500	Resistor, 1.5K, 5%, ¼W	81349	RC07GF152J
R8	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R9	25-25-100K	Resistor, 100K, 5%, ¼W	81349	RC07GF104J
R10	25-25-22K	Resistor, 22K, 5%, ¼W	81349	RC07GF223J
R11	25-25-4700	Resistor, 4.7K, 5%, ¼W	81349	RC07GF472J
R12	25-25-1500	Resistor, 1.5K, 5%, ¼W	81349	RC07GF152J
R13	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R14	25-25-100K	Resistor, 100K, 5%, ¼W	81349	RC07GF104J
R15	25-25-22K	Resistor, 22K, 5%, ¼W	81349	RC07GF223J
R16	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R17	25-25-330	Resistor, 330Ω, 5%, ¼W	81349	RC07GF331J
R18	25-25-4700	Resistor, 4.7K, 5%, ¼W	81349	RC07GF472J
R19	25-25-560K	Resistor, 560Ω, 5%, ¼W	81349	RC07GF564J
R20	25-25-100K	Resistor, 100K, 5%, ¼W	81349	RC07GF104J
R21	25-25-100K	Resistor, 100K, 5%, ¼W	81349	RC07GF104J
R22		Not Used		
R23		Not Used		
R24		Not Used		
R25		Not Used		
R26	25-25-1000	Resistor, 1K, 5%, ¼W	81349	RC07GF102J
R27	25-25-220	Resistor, 220Ω, 5%, ¼W	81349	RC07GF221J
R28	25-25-1000	Resistor, 1K, 5%, ¼W	81349	RC07GF102J
R29	25-25-220	Resistor, 220Ω, 5%, ¼W	81349	RC07GF221J
R30	25-25-4700	Resistor, 4.7K, 5%, ¼W	81349	RC07GF472J
R31	25-25-4700	Resistor, 4.7K, 5%, ¼W	81349	RC07GF472J
R32	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R33	25-25-10K	Resistor, 10K, 5%, ¼W	81349	RC07GF103J
R34	25-25-4700	Resistor, 4.7K, 5%, ¼W	81349	RC07GF472J
R35	25-25-4700	Resistor, 4.7K, 5%, ¼W	81349	RC07GF472J
R36	25-25-2200	Resistor, 2.2K, 5%, ¼W	81349	RC07GF222J
R37	25-25-2200	Resistor, 2.2K, 5%, ¼W	81349	RC07GF222J
R38	25-8-180	Resistor, 180Ω, 5%, ½W	81349	RC20GF181J
R39	25-8-180	Resistor, 180Ω, 5%, ½W	81349	RC20GF181J
R40	25-25-6800	Resistor, 6.8K, 5%, ¼W	81349	RC07GF682J
R41	25-25-6800	Resistor, 6.8K, 5%, ¼W	81349	RC07GF682J

TABLE 6-24. RF CABLE AND CONNECTOR PARTS LIST

CABLE LIST

PART NUMBER	DESCRIPTION	APPLICABILITY	MFR CODE	MFR PART NUMBER
68-14-3	Cable, Semi-Rigid; 50Ω	All except 436A	93306	UT 141A
79-87	Cable, Flex	All units	92194	RG 174/U
79-110	Cable, Semi-Rigid; .085 dia.	Model 436A only	92194	RF 405/U

CONNECTOR LIST

PART NUMBER	DESCRIPTION	APPLICABILITY	MFR CODE	MFR PART NUMBER
63-118-1	PLUG, SMA	All units	00779	225422-8
63-120	ADAPTER, M/M, SMA	431A, 432A and 433A "-1" or "B" options only	15311	901-118
B136-137	ADAPTER, SMA to "N"	431A, 432A, 433A and 434A EXCEPT "-1" option	93459	B136-137
B136-111	ADAPTER, N to SMA	431A, 432A, 433A, and 434A "-1" option	93459	B136-111
B139-587	ADAPTER, M/F, SMA	435A Front panel mount	93459	B139-587
B139-587-1	ADAPTER, F/F, SMA	435A Rear panel mount	93459	B139-587-1
B89-1309	ADAPTER, WPM-3	436A Front panel mount	93459	B89-1309
62-187	Conn, SMC-Male	436A Only	16179	251-2
62-147	Conn, SMA-Male	436A Only	83330	221 BK
63-112	Conn, Bulkhead, "N"	438A Only	14298	3004-7941
63-102	Conn, Straight Plug	435A Only	98291	50-007-0000

*F/F – Female to Female
*M/M–Male to Male
*M/F –Male to Female

SECTION 7

ASSEMBLY DRAWINGS AND SCHEMATICS

7.1 INTRODUCTION

This section contains assembly drawings, schematic diagrams and component location drawings for the RF Unit Assembly and subassemblies. Table 7-1, on the following page, provides schematic notes which are unique to the diagrams and drawings of this section.

7.2 LIST OF FIGURES

The following is a list of figures included in this section.

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TABLE 7-1. SCHEMATIC NOTES

1. Resistance in ohms, capacitance in microfarads unless otherwise indicated.

2.  Screwdriver adjustment

    Front panel control

3.  Front panel designation

    Rear panel designation

4. Printed circuit card border

    Main signal path

    Semi Rigid Coaxial

5. P/O = part of

6. 

   Wiper moves toward CW when control rotated clockwise

7.  Test point

8.  Zener diode,  SCR

9.  Cons. Current Diode

10. 

    Indicates Socket connections and pin numbers.

11. 

    Indicates solder connection and pin numbers.

12.  Denotes chassis ground

13. 

    Denotes Power Return

    Denotes Reference Return

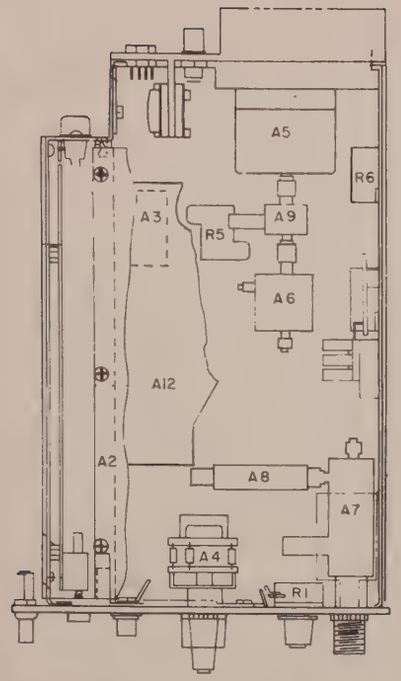
    Denotes Tuning Voltage Return

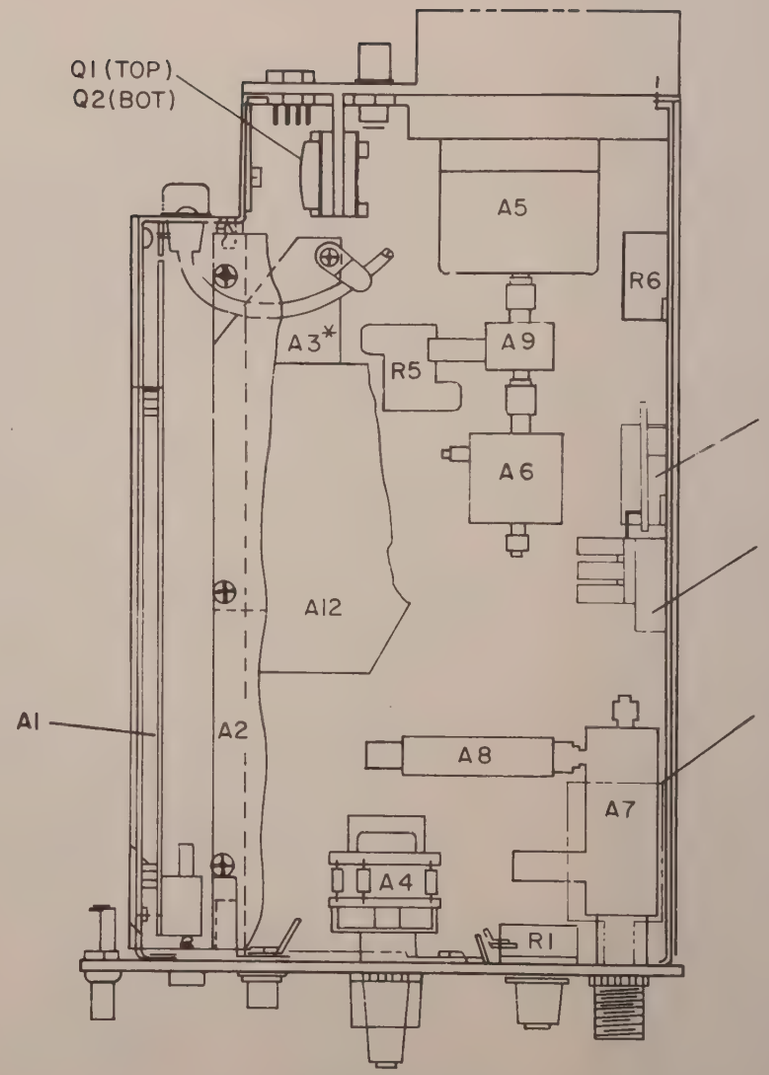
    Denotes FM CKT Return

    Denotes 5-Volt Return



A3 BOARD LOCATION ON LATER UNITS



R7 (BOT) (APPLIES ONLY TO MODELS 434A AND 435A)

TOP VIEW

A11 (APPLIES ONLY TO MODELS 434A, 435A, 435A/4309A, AND 444A)

A10 (OPTION B)

REAR PANEL ASSY



ON MODEL 431A ONLY

FRONT PANEL ASSY

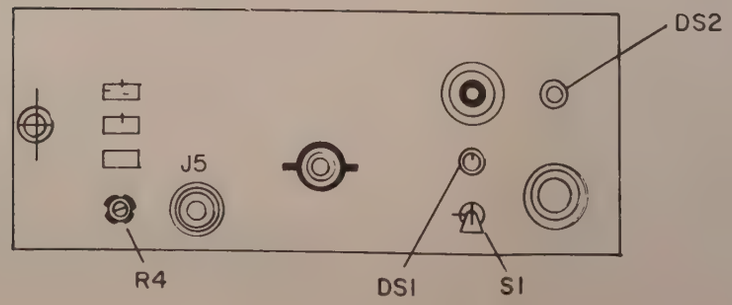


Figure 7-1. YIG Tuned RF Unit, Assembly and Component Identification, All Models Except 438A and 435A/ 4309A

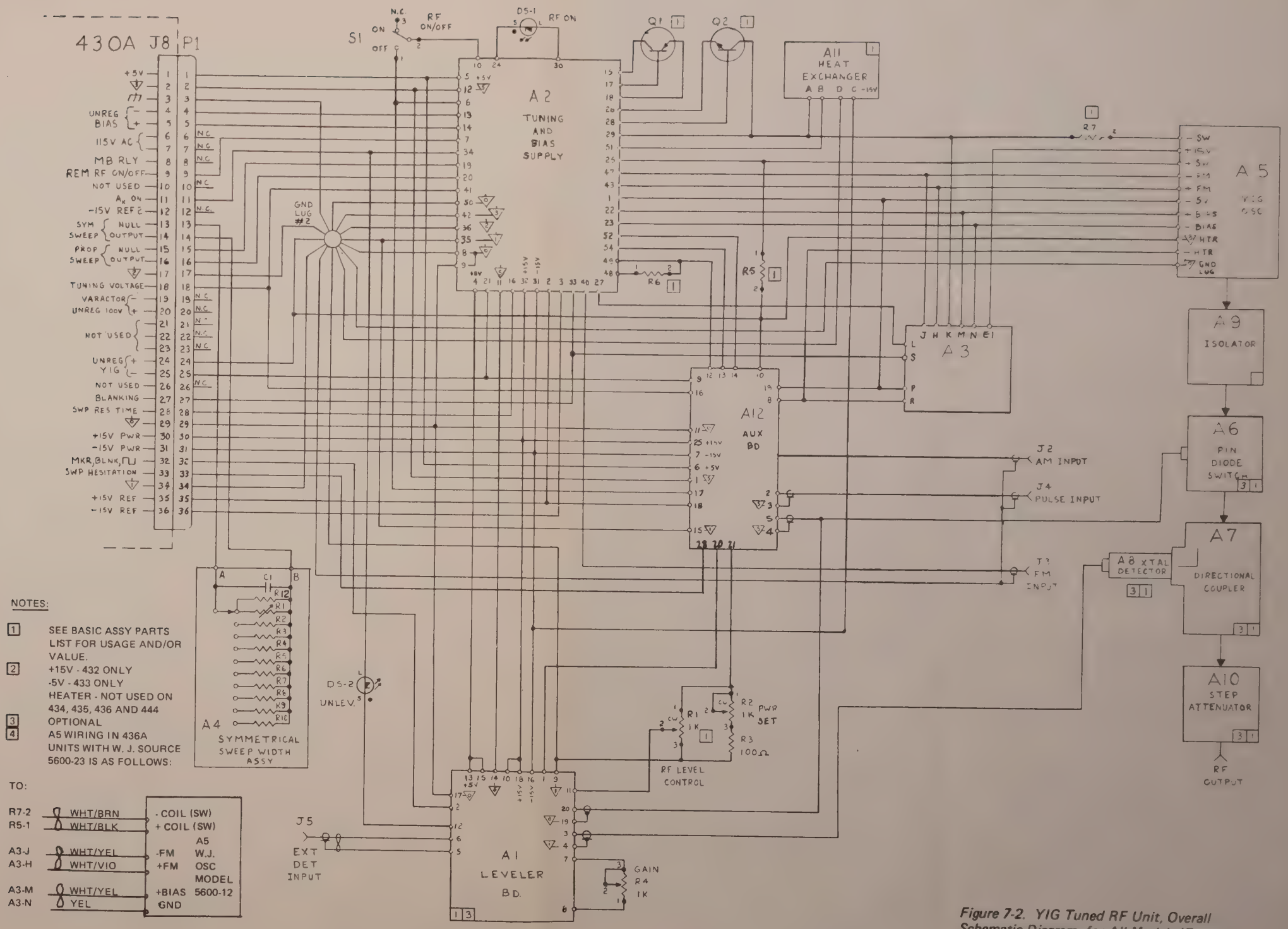
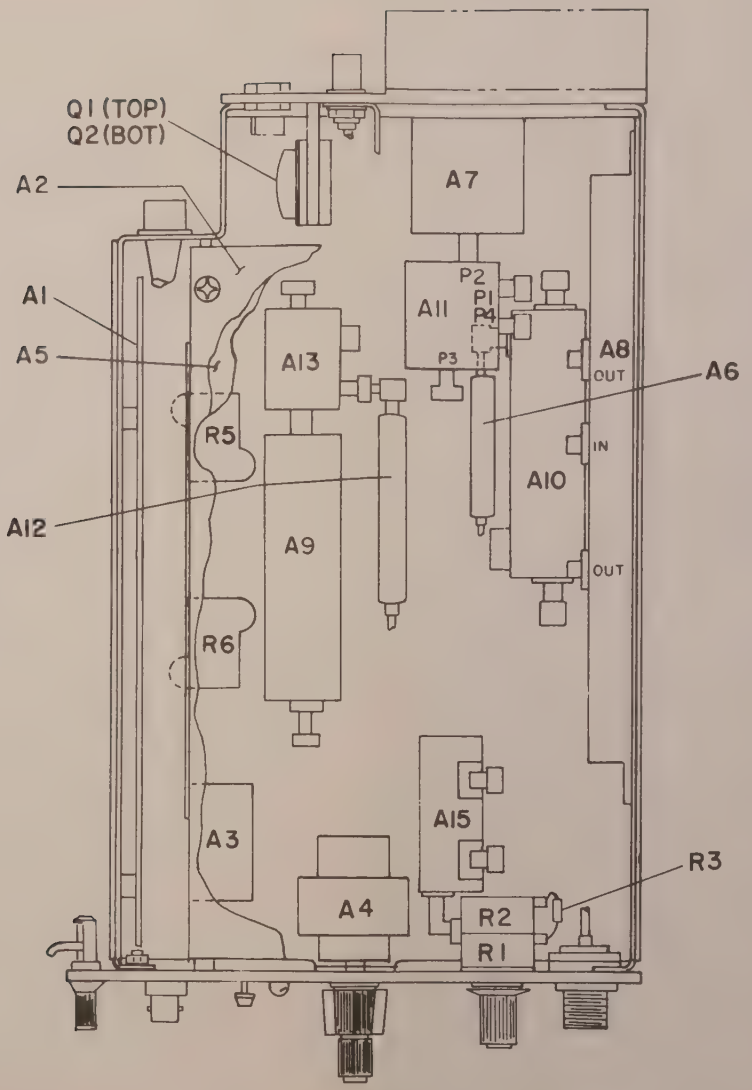
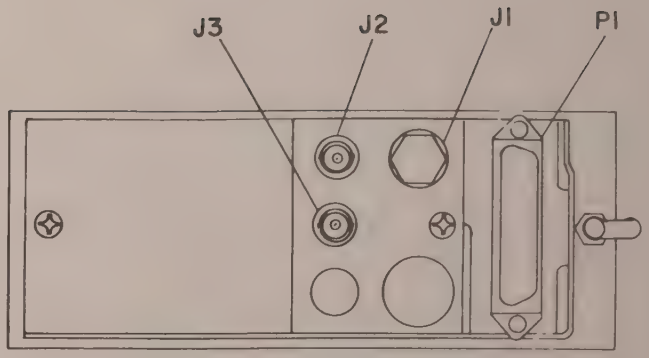


Figure 7-2. YIG Tuned RF Unit, Overall Schematic Diagram, for All Models (Except 438A and 435A/4309A) with A3 Board Without Reference Supply

FIGURE 7-3

NOT USED





REAR VIEW

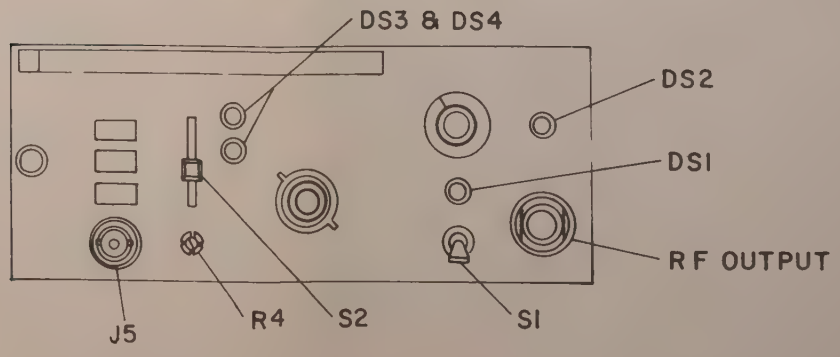
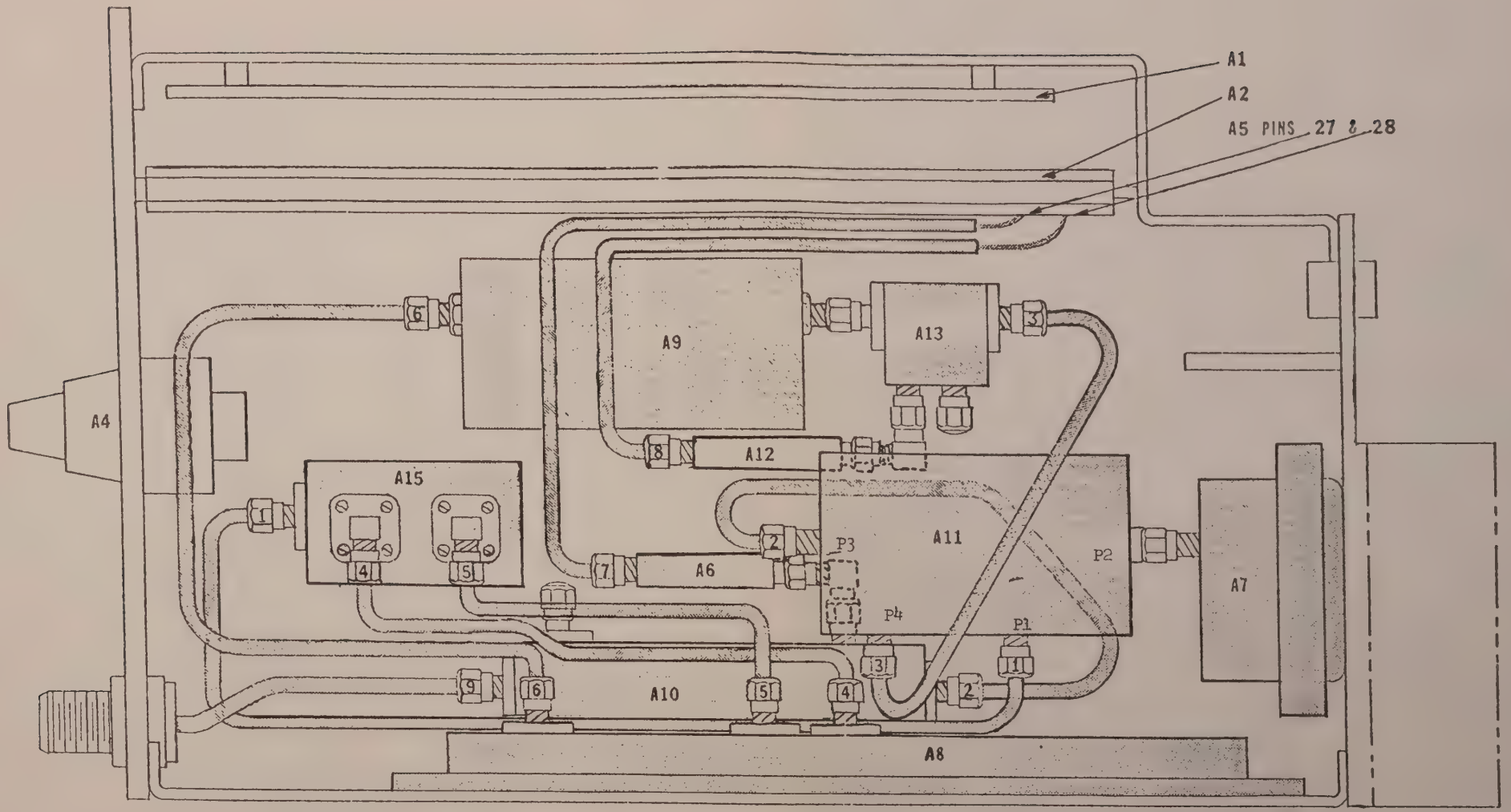


Figure 7-4. Model 438A YIG Tuned RF Unit, Assembly and Component Identification



CABLE NO.	COLOR	TYPE	DESTINATION
1	BROWN	RG-174	A11 PORT 1 TO A15 (R.F.)
2	RED	RG-174	A11 PORT 3 TO A10 INPUT
3	ORANGE	RG-174	A13 OUTPUT TO A11 PORT 4
4	YELLOW	RG-174	A8 OUTPUT TO A15 (L.O.)
5	GREEN	RG-174	A15 OUTPUT TO A8 FILTER
6	BLUE	RG-174	A8 FILTER TO A9 INPUT
7	VIOLET	RG-174	A6 OUTPUT TO A5-27
8	GRAY	RG-174	A12 OUTPUT TO A5-28
9	WHITE	UT-141	A10 OUTPUT TO R.F. OUTPUT

NOTE: CABLES WILL BE COLOR CODED AT EITHER END, ON THE CONNECTORS. MATING CONNECTORS WILL BE IDENTICALLY CODED.

Figure 7-5. Model 438A RF Cable Interconnection Diagram

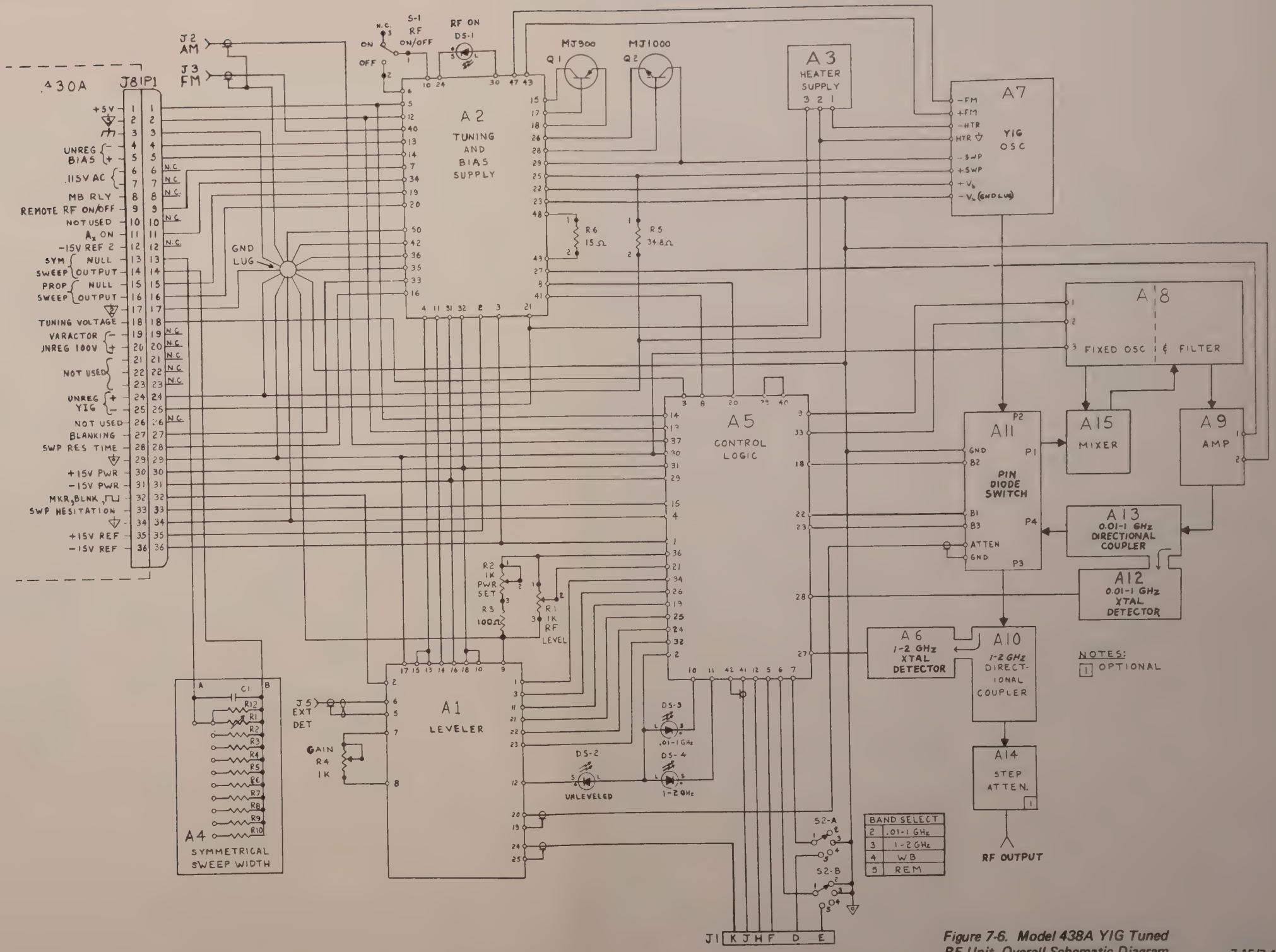


Figure 7-6. Model 438A YIG Tuned RF Unit, Overall Schematic Diagram

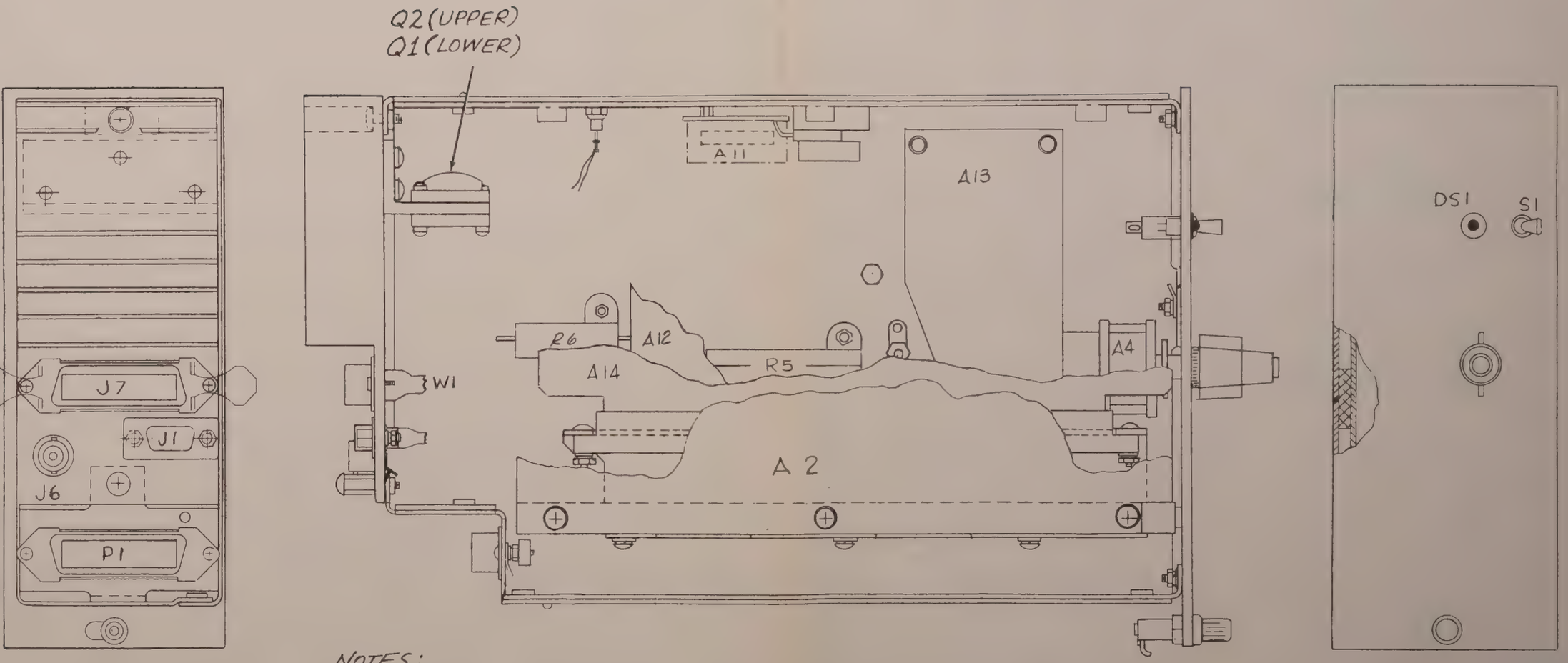


Figure 7-7. Model 435A/4309A Interface Unit, Assembly and Component Identification (Serial =1994 and Above)

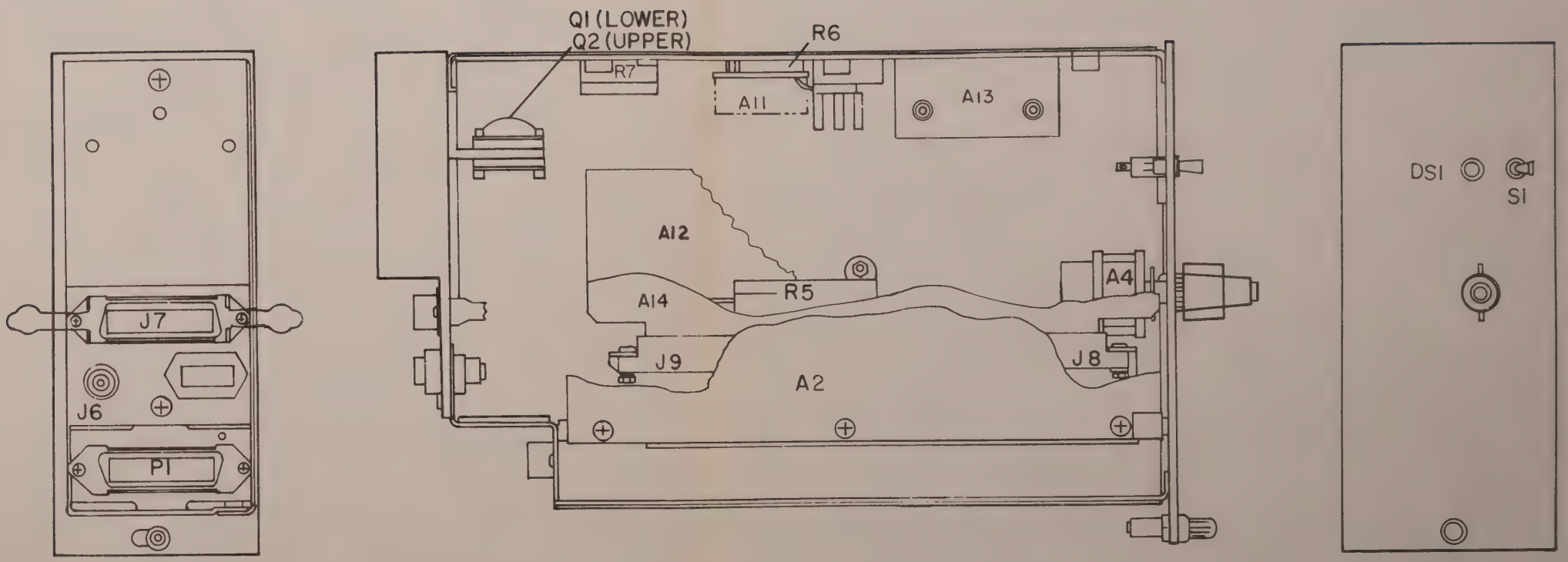


Figure 7-8. Model 435A/4309A Interface Unit, Assembly and Component Identification (Serial # below 1994)

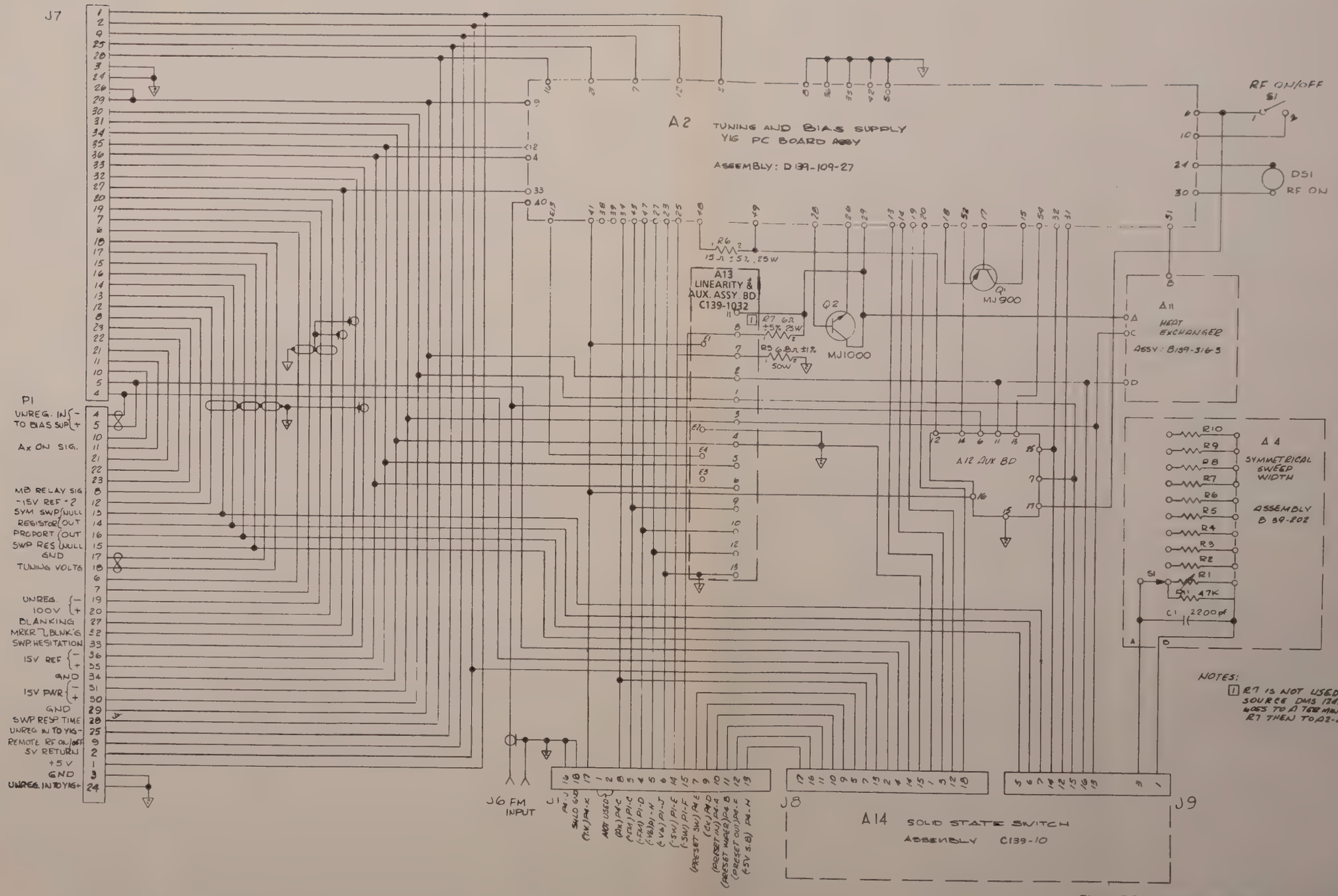


Figure 7-9. Model 435A/4309A Interface Unit, Overall Schematic Diagram (Serial #1994 and Above)

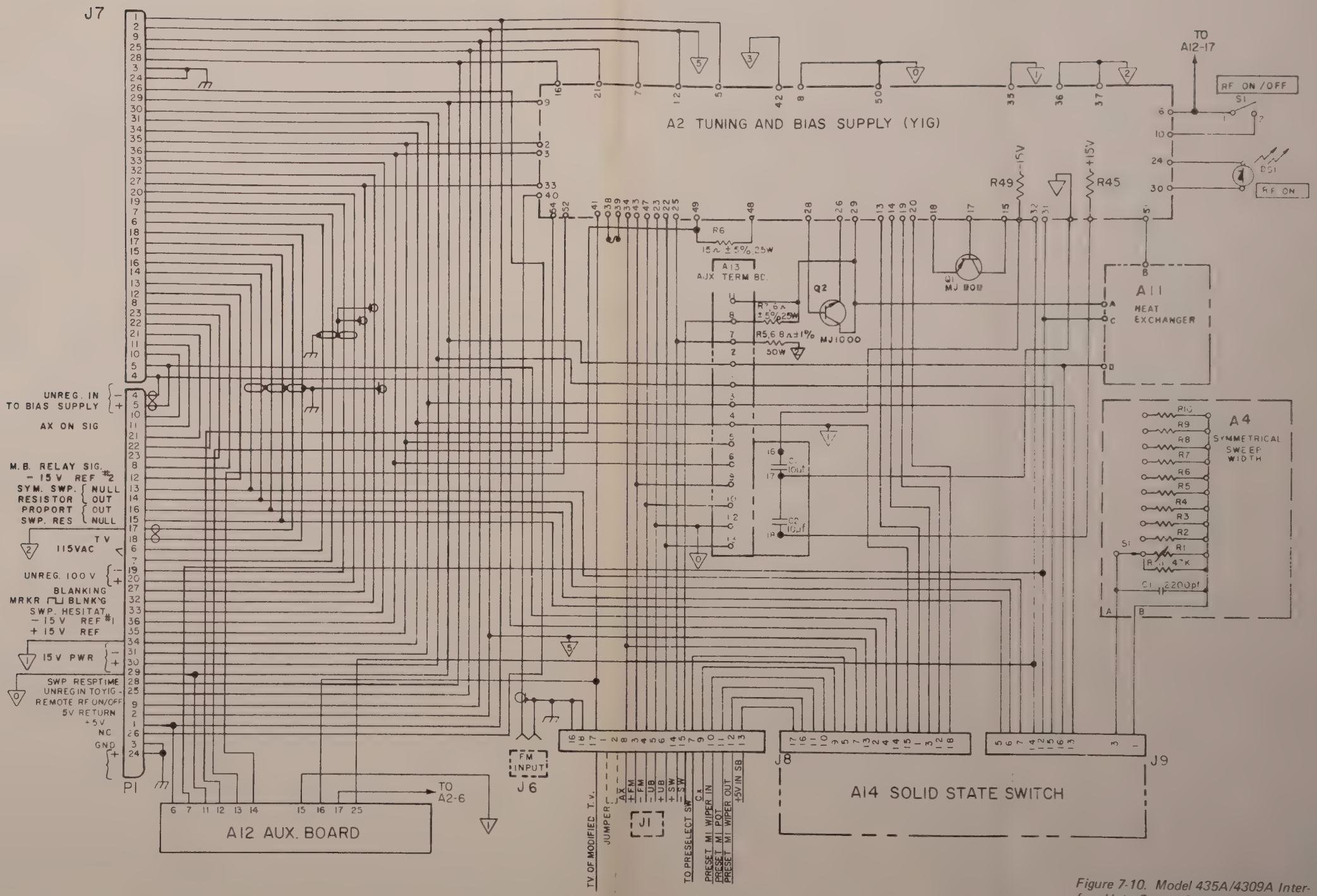


Figure 7-10. Model 435A/4309A Interface Unit, Overall Schematic Diagram (Serial # below 1994)

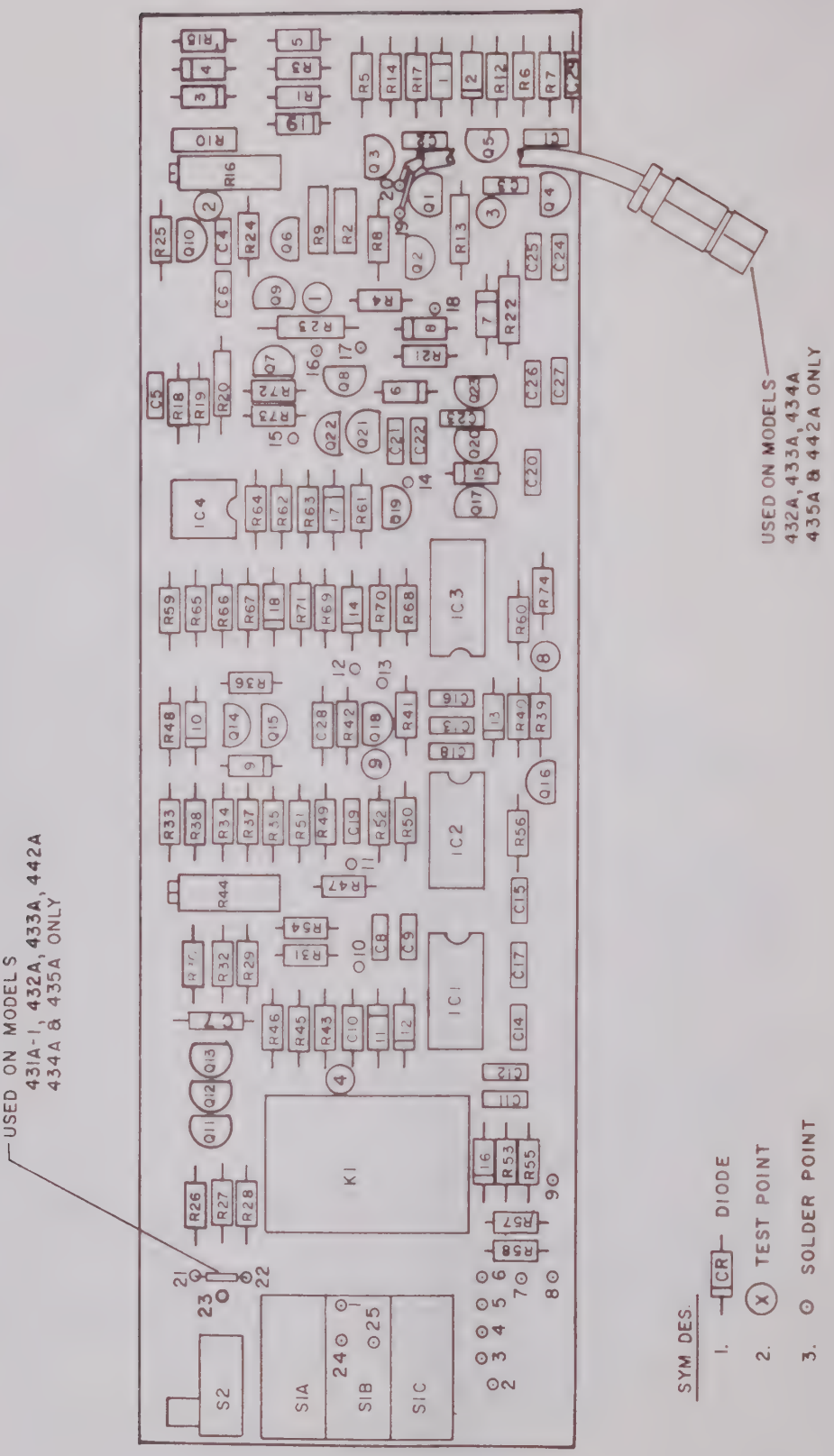


Figure 7-11. Assembly A1 Leveler, Component Identification, All Models Except 435A/4309A

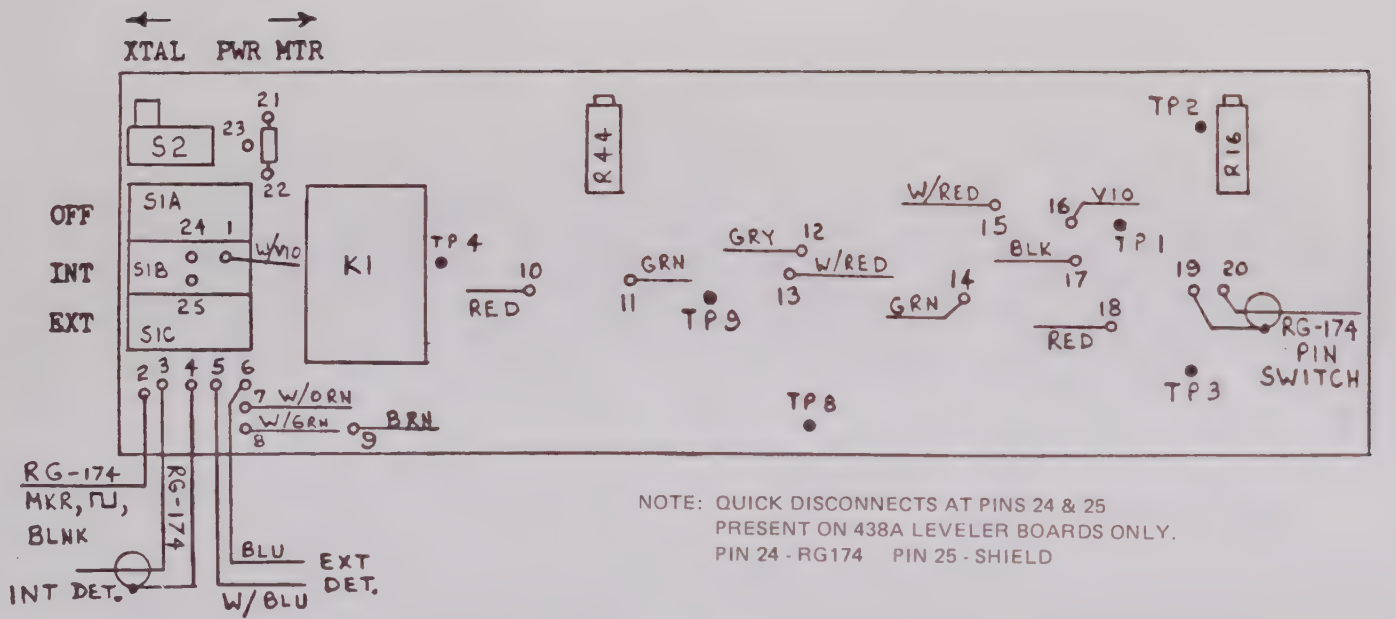


Figure 7-12. A1 Leveler Board Quick Disconnect Lead and Pin Location Diagram

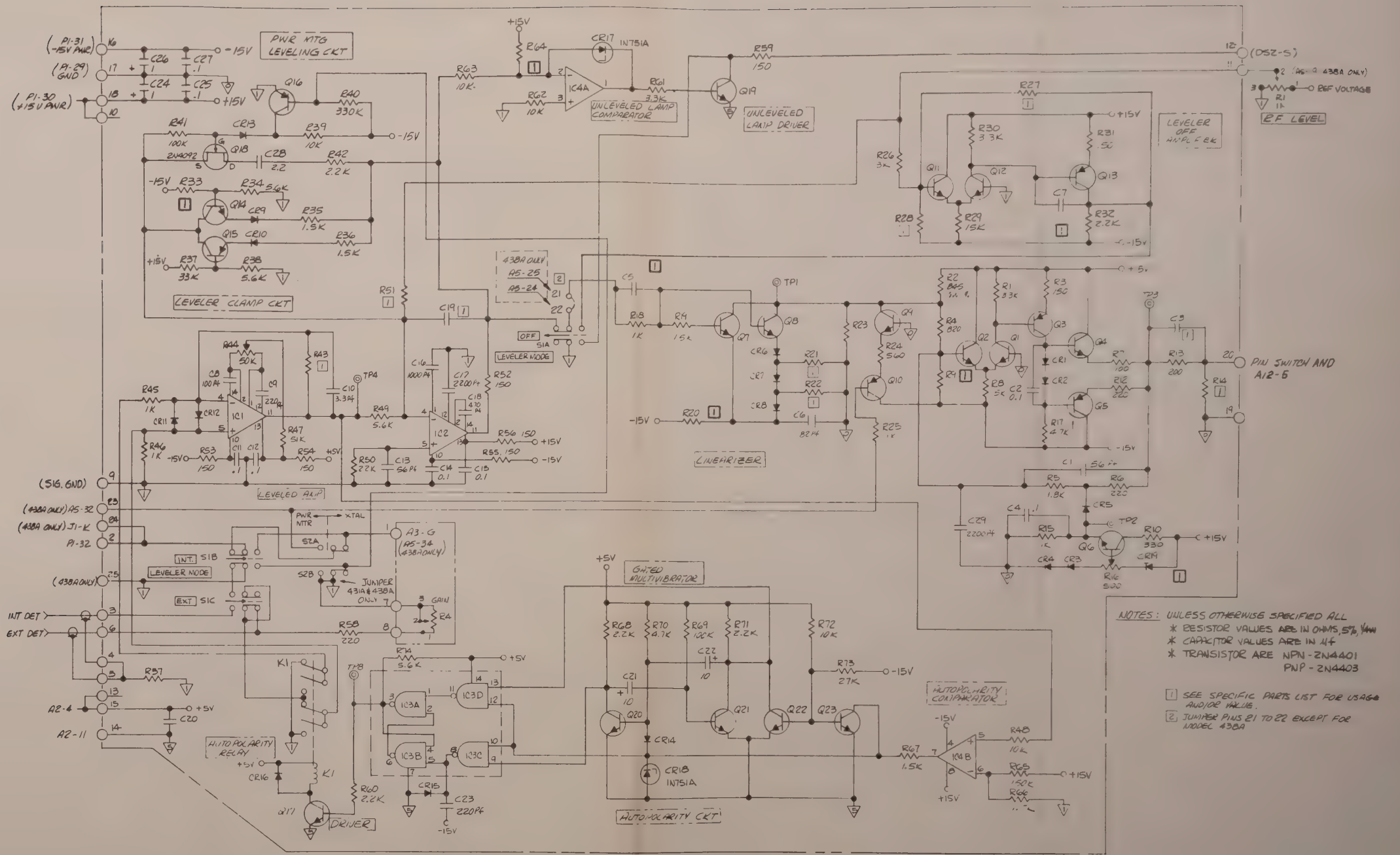


Figure 7-13. Assembly A1 Leveler, Schematic Diagram, All Models Except 435A/4309A

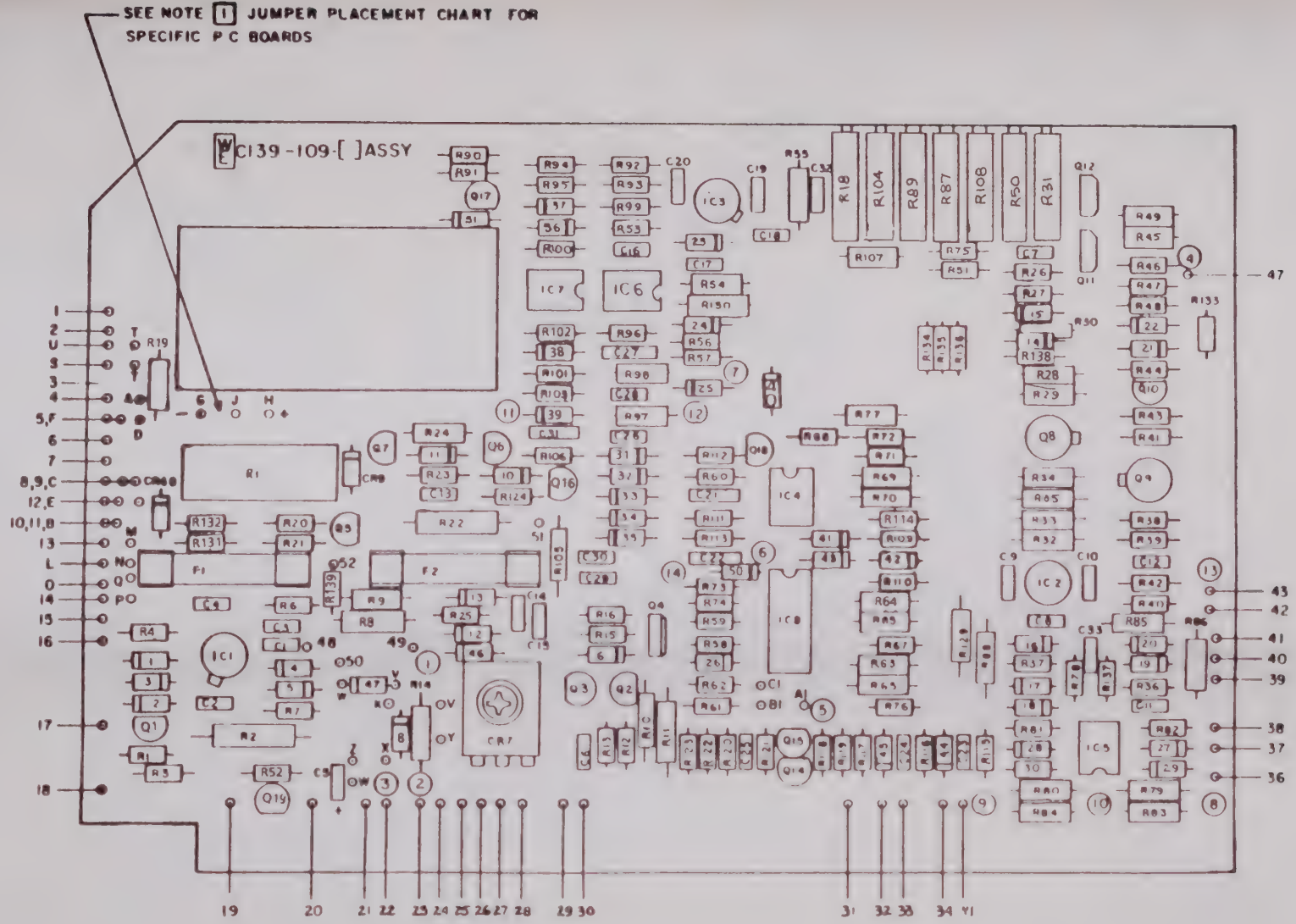
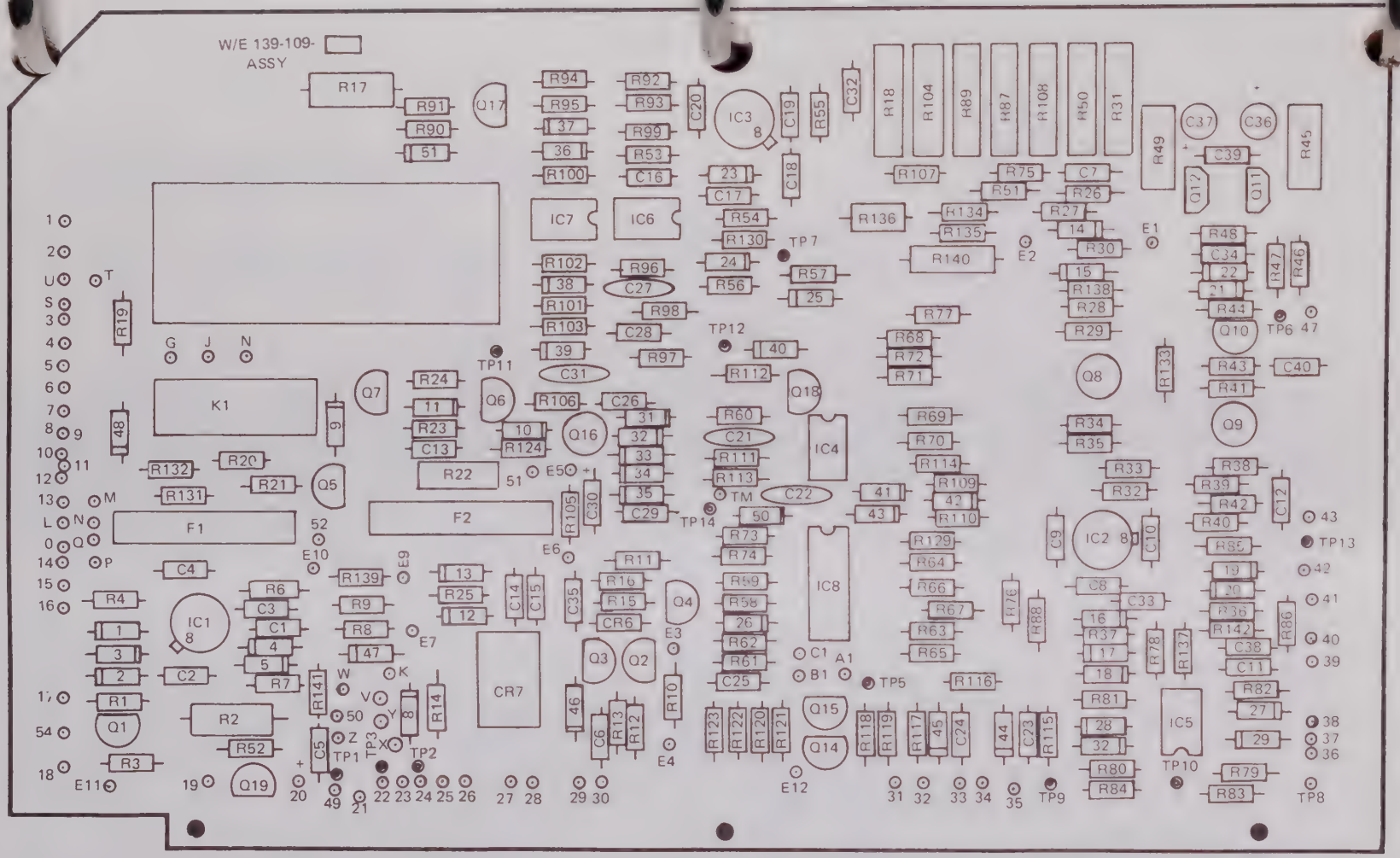

SEE NOTE 1 JUMPER PLACEMENT CHART FOR SPECIFIC P C BOARDS
C139-109-[ ]ASSY
SYM. DES.
1. DIODE
2. TEST POINT
3. SOLDER POINT
4. R11 MAY HAVE 0.1 µf CAPACITOR IN PARALLEL
COMPONENT LOCATIONS AS SHOWN ABOVE IDENTIFY ALL COMPONENTS

Figure 7-14. Assembly A2, YIG Bias and Tuning Supply. Component Identification (All Models at Rev. Level 'F')



444A	VARIAN	PC139-109-26	434A	VARIAN	PC139-109-11
442A	AVANTEK	PC139-109-21	434A	AVANTEK	PC139-109-23
438A	AVANTEK	PC139-109-19	433A	AVANTEK	PC139-109-15
437A	W.J.	PC139-109-24	432A	AVANTEK	PC139-109-21
436A	VARIAN	PC139-109-25	431A	AVANTEK	PC139-109-20
435A/4309A	VARIAN	PC139-109-22	MODEL	SOURCE	PARTS LIST
435A	VARIAN	PC139-109-12			

NOTES

1. SEE SPECIFIC PARTS LIST FOR VALUES AND USAGE.

SYM. DES.

1. —|CR|— DIODE
2. (X) TEST POINT
3. ⊙ SOLDER POINT

Figure 7-15. Assembly A2 YIG Bias and Tuning Supply, Component Identification (All Models, Rev G and Up)

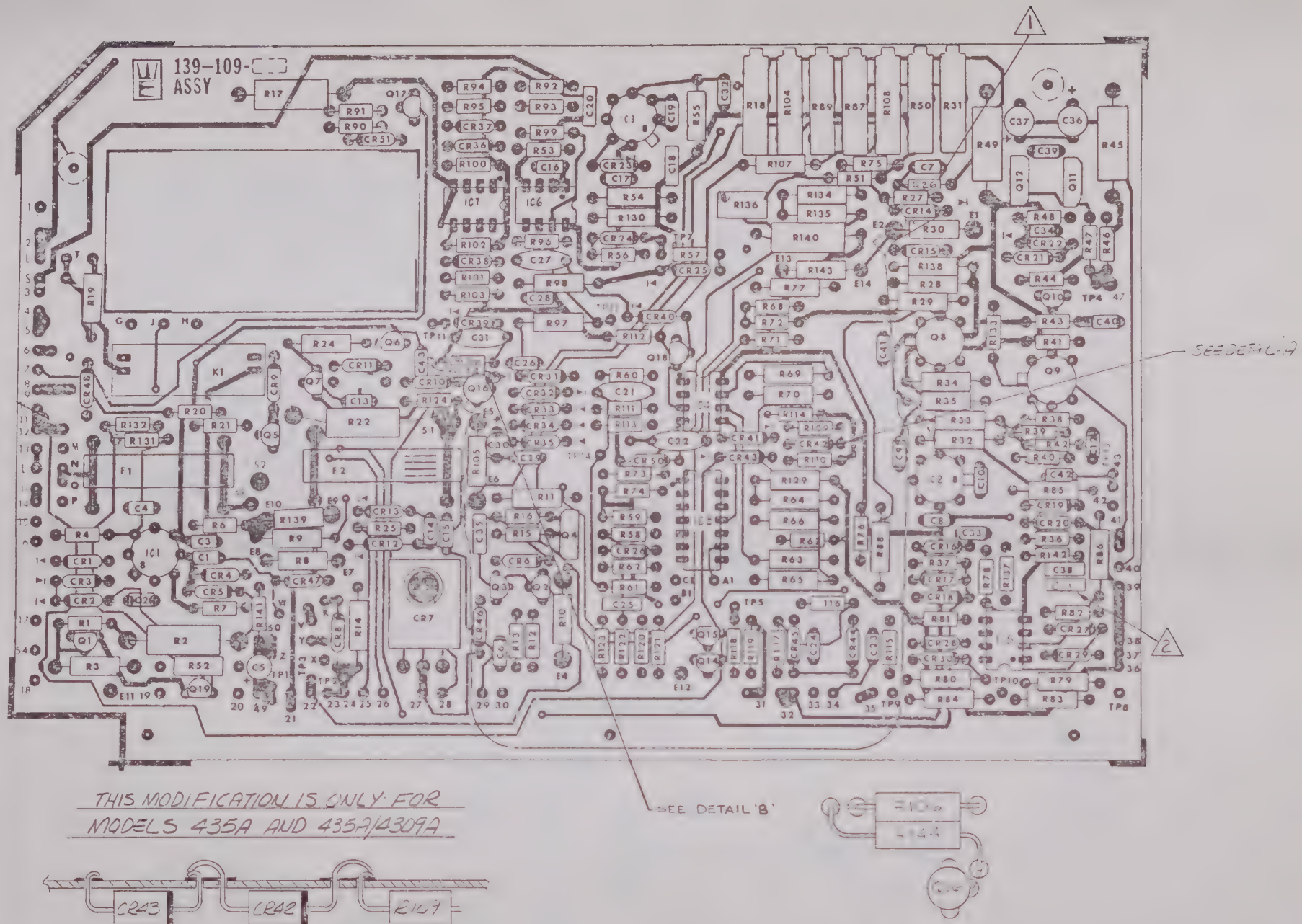

139-109-
ASSY
THIS MODIFICATION IS ONLY FOR MODELS 435A AUD 435A/4309A
SEE DETAIL 'B'
SEE DETAIL 'A'
CR43
CR42
CR41
DETAIL 'A'
DETAIL 'B'
NOT USED ON MODELS 436A, 437A, + 442A
R26 NOT USED ON MODELS 431A, 432A, 433A, 434A, 435A, 435A/4309A, + 438A
C11 NOT USED ON MODELS 431A, 432A, 433A, 434A, 435A, 435A/4309A + 438A. INSTALL JUMPER USING ITEM 299.

Figure 7-16. Assembly A2 YIG Bias and Tuning Supply, Component Identification, All Models, Serial No. 1994 and Up)

MODEL		433A	434A		435A		442A
Type REGULATOR	POS	POS	NEG	POS	NEG	POS	POS
Type TRANSISTOR Q1 Q19	2N4403	2N4403	2N4401	2N4403	2N4401	2N4403	2N4403
JUMPER PLACEMENT	W V Y V Y K X Z S T J H M L N O B1 C1	Y K Y V W V X Z S T J H M L N O B1 C1 D1 E1	W V W X Y K K Z U T J G N L P O B1 C1	W V Y V Y K X Z S T J H M L N O B1 C1	W V Z K Y K X W U T J G N L P O C1 B1	W V Y V Y K X Z S T J H M L N O B1 C1	W V Y V Y K X Z S T J H M L N O C1 B1

*Applicable to Models 431A, 432A, 436A, 438A, and 444A

NOTE: TRANSISTORS Q1 AND Q19 AND JUMPER PLACEMENT DIFFER DUE TO THE VARIOUS RF SOURCE BIAS REQUIREMENTS FOR DIFFERENT MODEL RF UNITS AS LISTED ABOVE.

Figure 7-17. Bias Tuning Voltage Transistor Type and Jumper Placement

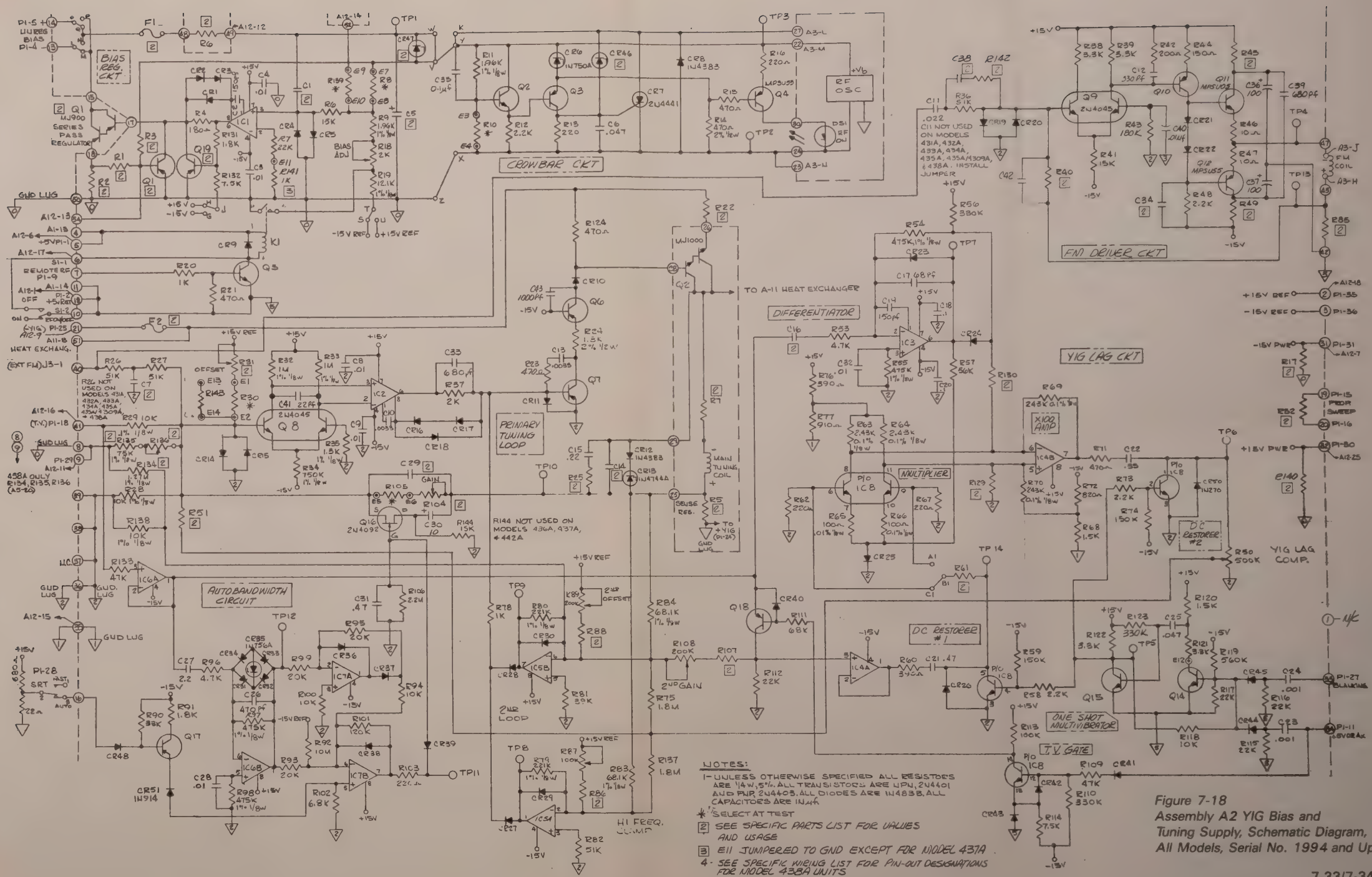
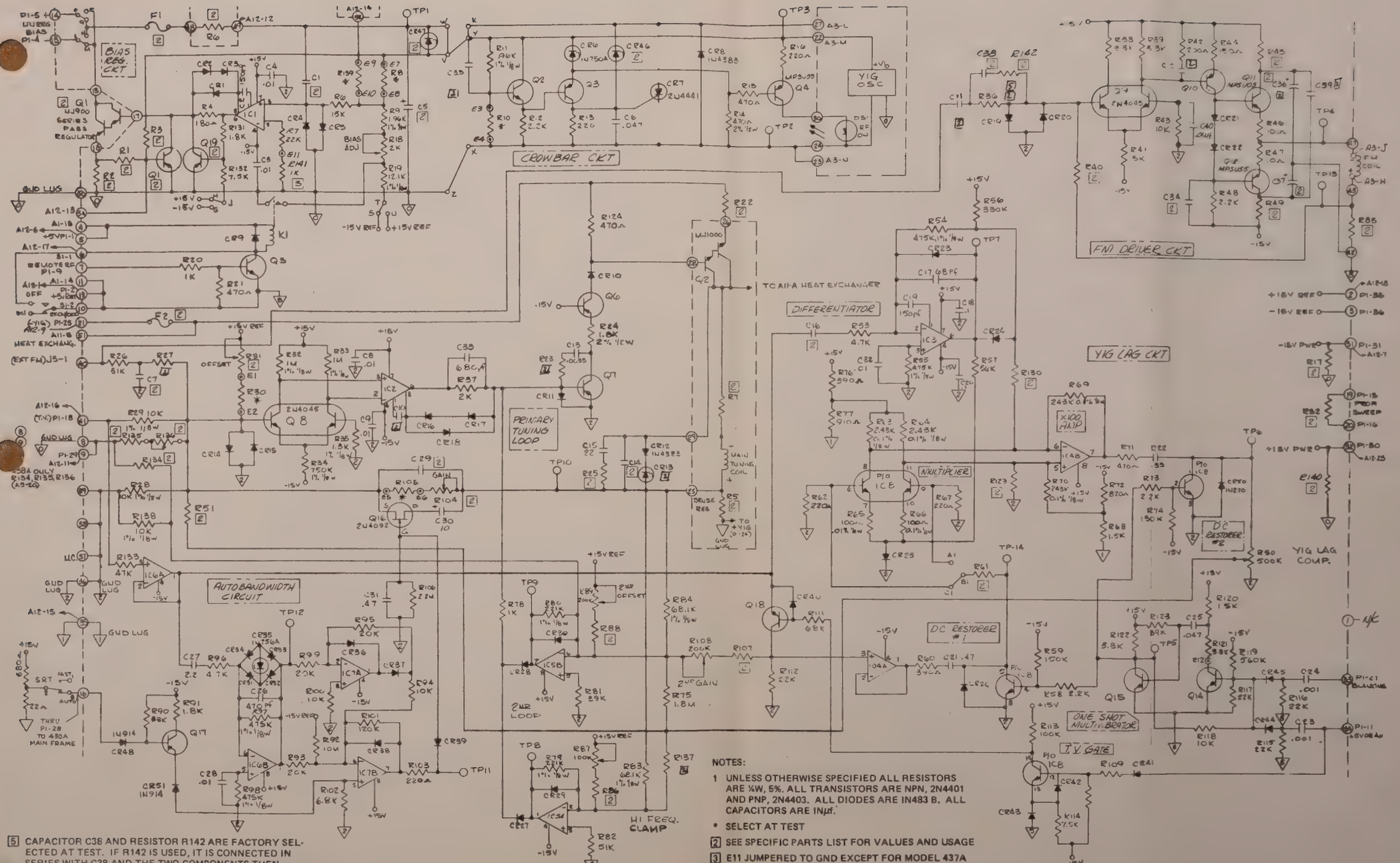

BIAS REG. CKT
CROWBAR CKT
RF OSC
FM DRIVER CKT
YIG LAG CKT
DIFFERENTIATOR
PRIMARY TUNING LOOP
MULTIPLIER
X100 AMP
DC RESTORER #1
DC RESTORER #2
YIG LAG COMP.
AUTOBANDWIDTH CIRCUIT
2ND LOOP
2ND GAIN
ONE SHOT MULTIVIBRATOR
T.V. GATE
HI FREQ. COMP
TO A-11 HEAT EXCHANGER
NOTES:
1- UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE 1/4 W, 5%. ALL TRANSISTORS ARE UPN, 2N4401 AND PNP, 2N4403. ALL DIODES ARE IN4838. ALL CAPACITORS ARE IN4K
* SELECT AT TEST
2 SEE SPECIFIC PARTS LIST FOR VALUES AND USAGE
3 E11 JUMPERED TO GND EXCEPT FOR MODEL 437A
4 - SEE SPECIFIC WIRING LIST FOR PIN-OUT DESIGNATIONS FOR MODEL 438A UNITS

Figure 7-18
Assembly A2 YIG Bias and Tuning Supply, Schematic Diagram, All Models, Serial No. 1994 and Up



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE ¼W, 5%. ALL TRANSISTORS ARE NPN, 2N4401 AND PNP, 2N4403. ALL DIODES ARE IN483 B. ALL CAPACITORS ARE INμf.
- SELECT AT TEST
2. SEE SPECIFIC PARTS LIST FOR VALUES AND USAGE
3. E11 JUMPERED TO GND EXCEPT FOR MODEL 437A
4. REFER TO APPROPRIATE RF UNIT (OR INTERFACE UNIT) OVERALL SCHEMATIC DIAGRAM FOR PIN OUT DESIGNATIONS

5. CAPACITOR C38 AND RESISTOR R142 ARE FACTORY SELECTED AT TEST. IF R142 IS USED, IT IS CONNECTED IN SERIES WITH C38 AND THE TWO COMPONENTS THEN PARALLEL R36. IF R142 IS NOT USED, ONLY C38 PARALLELS C36.

6. FOR ANY RESISTOR INDICATED AS FACTORY SELECT (I.E. R10#) INSTALLATION OF ONE OR MORE RESISTORS IN SERIES OR PARALLEL MAY BE REQUIRED TO ACHIEVE THE PROPER VALUE.

Figure 7-19. YIG Bias and Tuning Supply, Schematic Diagram, All Models, Serial No. Below 1994

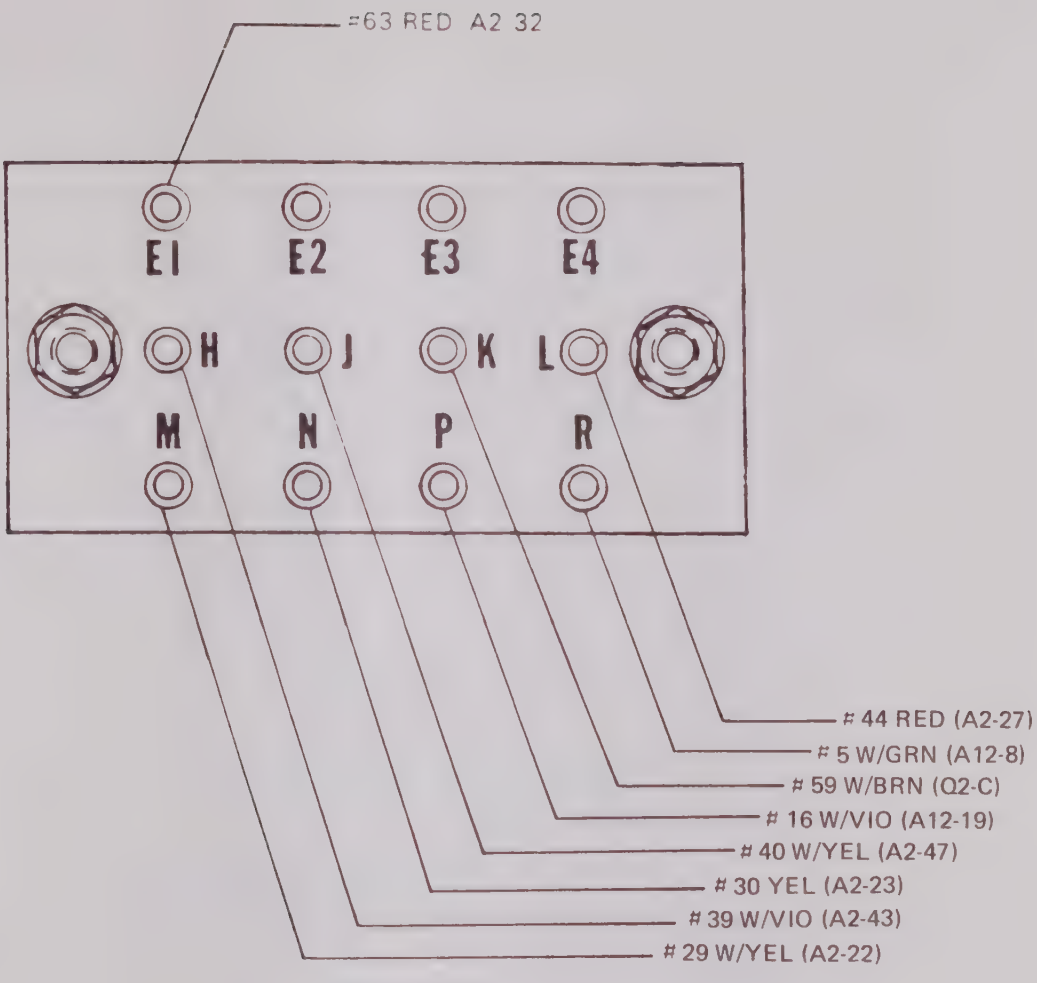
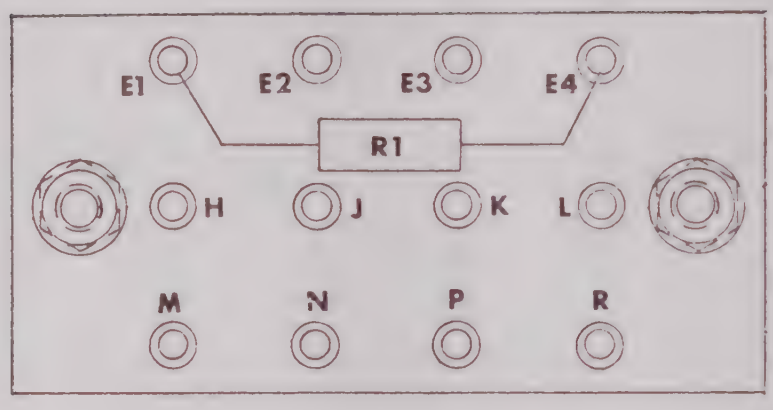


Figure 20. Assembly A3, ***Auxiliary Termination Board, Wiring Diagram***



NOTES:

1. R1 IS ONLY USED ON MODEL 433AH UNITS; SEE TABLE 6-7.

2. MODEL 433AH UNITS ALSO REQUIRE GND WIRE (BLK) #26 AWG FROM A3-E4 TO GND LUG #2.

Figure 7-21
Assembly A3, Auxiliary Termination Board, Component Identification, All Models Except 438A and 435A/4309A

Figure 7-22

Not Used

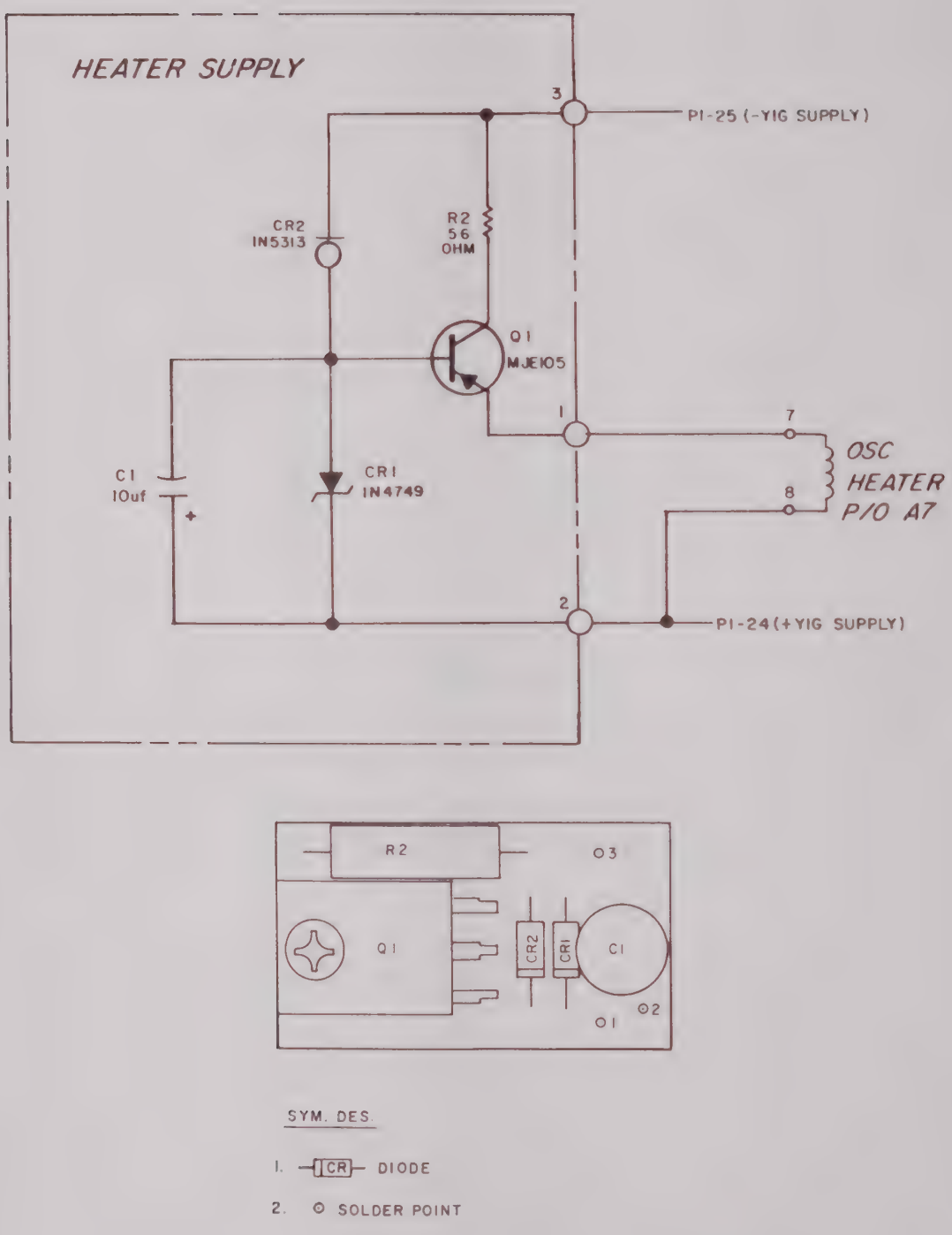


Figure 7-23. Assembly A3 Heater Supply, Schematic Diagram and Component Identification, Model 438A Only

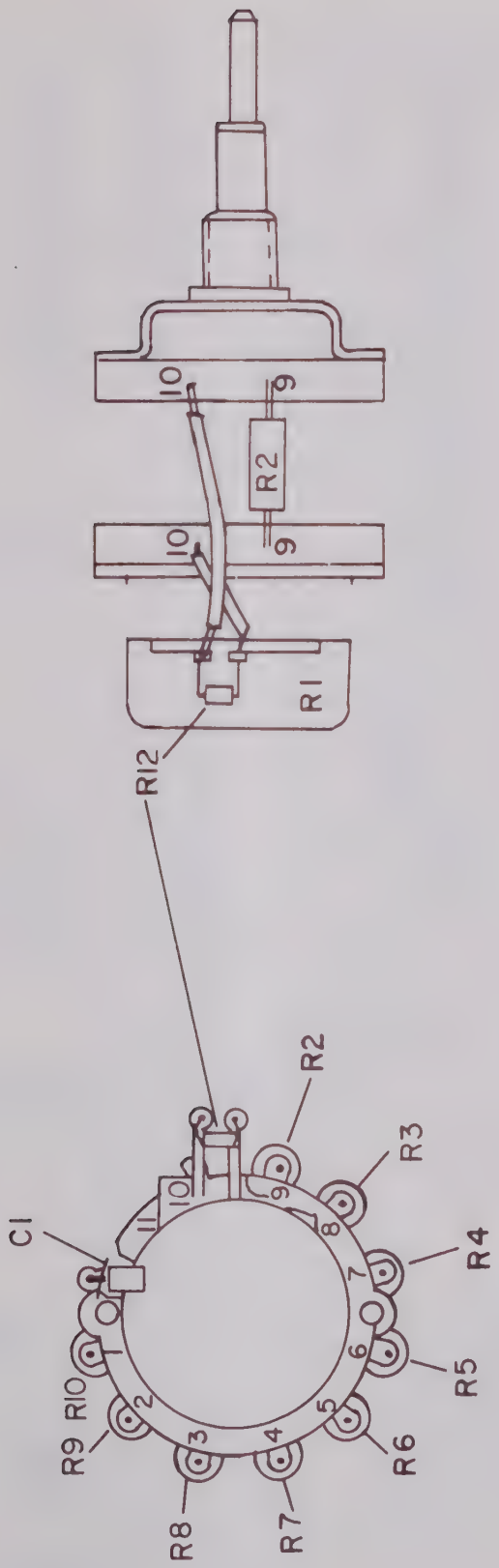


Figure 7-24. Assembly A4 Symmetrical Sweep Switch, Wiring Diagram and Component Identification, All Models

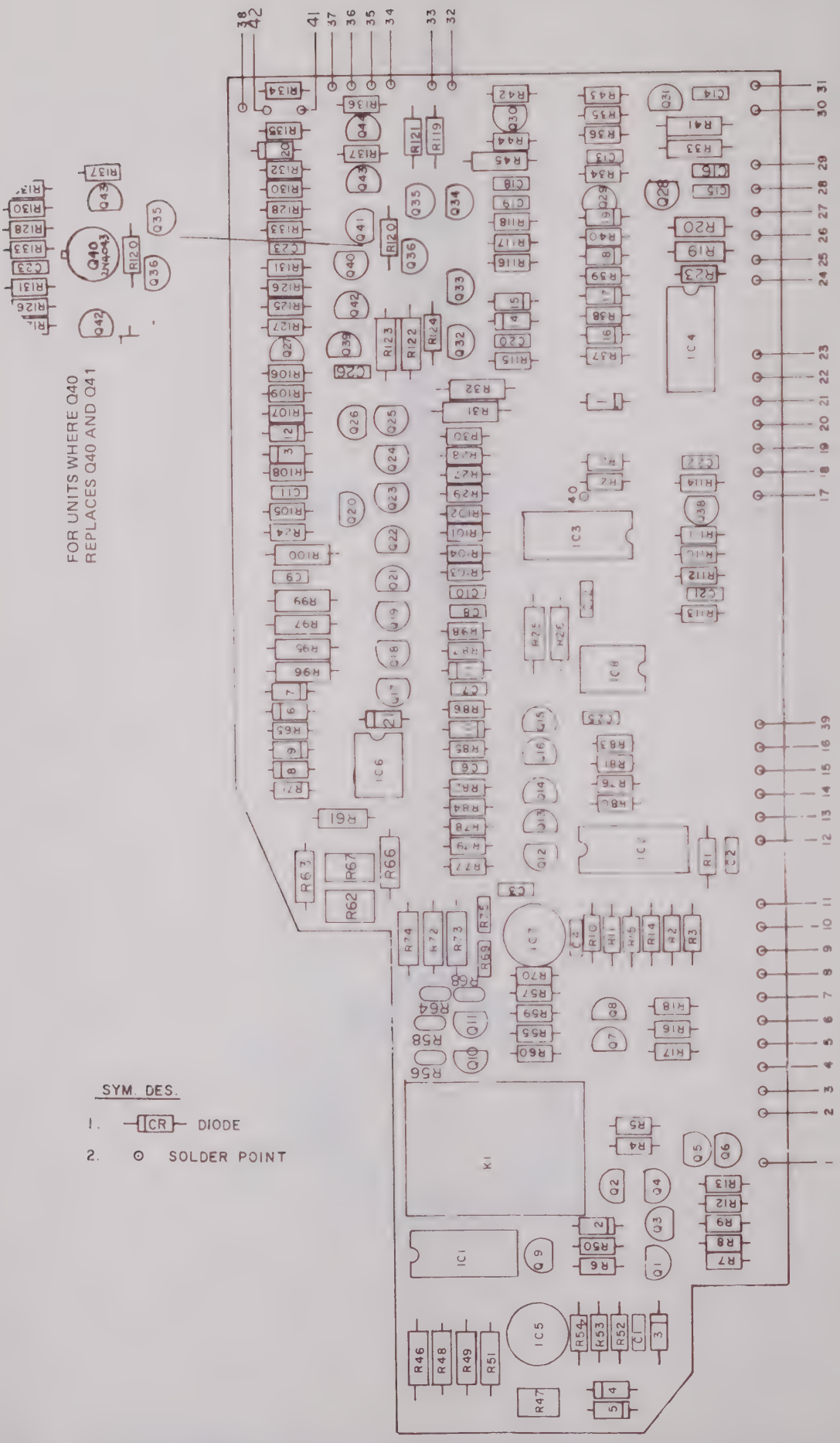


Figure 7-25. Assembly A5 Control Logic, Component Identification, Model 438A Only

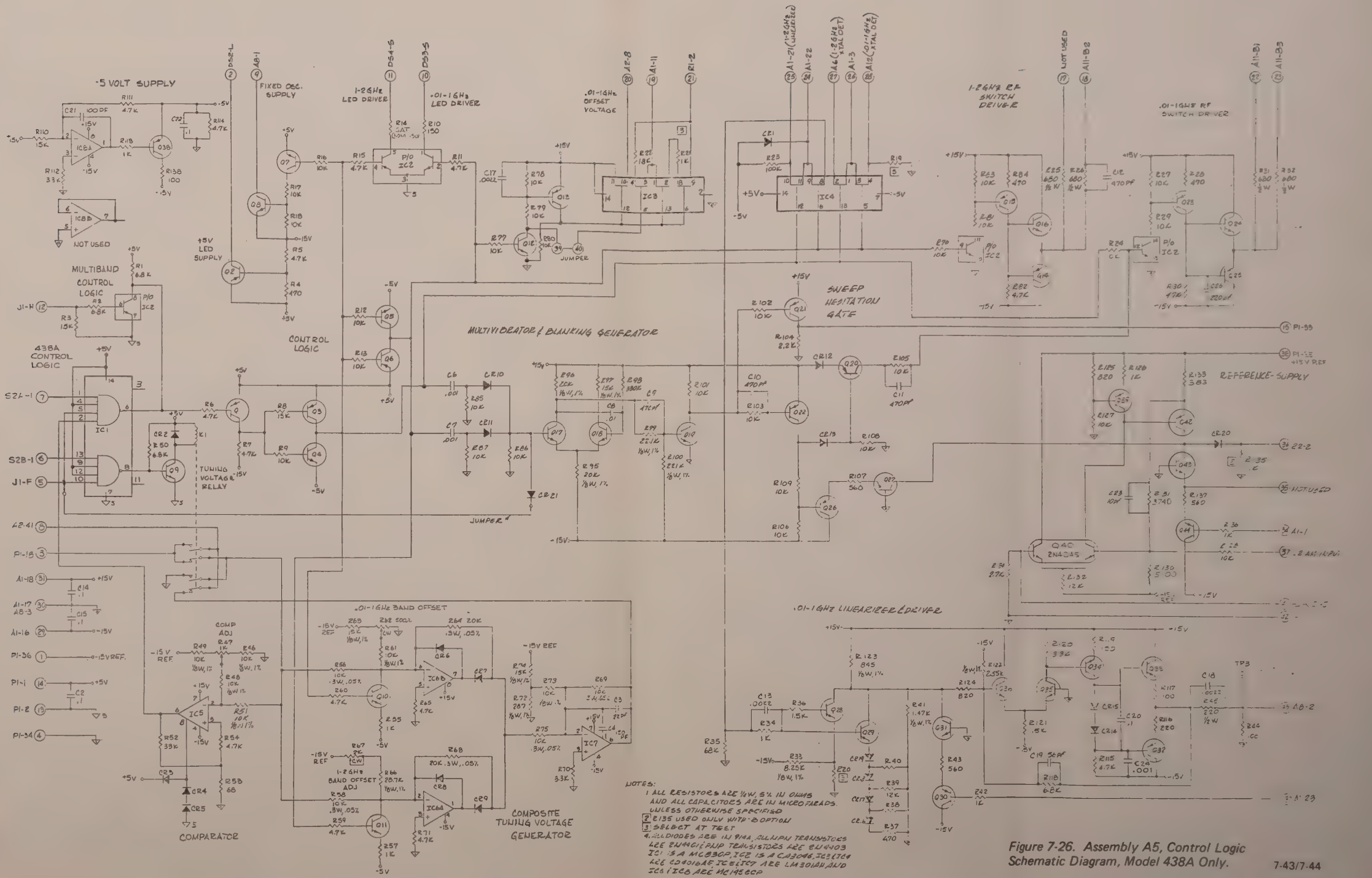

-5 VOLT SUPPLY
FIXED OSC. SUPPLY
1-2GHz LED DRIVER
.01-1GHz LED DRIVER
.01-1GHz OFFSET VOLTAGE
1-2GHz RF SWITCH DRIVER
.01-1GHz RF SWITCH DRIVER
NOT USED
+5V LED SUPPLY
MULTIBAND CONTROL LOGIC
CONTROL LOGIC
438A CONTROL LOGIC
MULTIVIBRATOR & BLANKING GENERATOR
SWEEP HESITATION GATE
REFERENCE SUPPLY
TUNING VOLTAGE RELAY
JUMPER
COMP ADJ
.01-1GHz BAND OFFSET
1-2GHz BAND OFFSET ADJ
COMPARATOR
COMPOSITE TUNING VOLTAGE GENERATOR
.01-1GHz LINEARIZER/DRIVER
NOTES:
1 ALL RESISTORS ARE 1/4W, 5% IN OHMS AND ALL CAPACITORS ARE IN MICROFARADS. UNLESS OTHERWISE SPECIFIED
2 R135 USED ONLY WITH -B OPTION
3 SELECT AT TEST
4 ALL DIODES ARE 1N 914, ALL NPN TRANSISTORS ARE 2N3904 EXCEPT Q40 IS A 2N4046, ALL PNP TRANSISTORS ARE 2N4036 EXCEPT Q31 IS A LM301AH, AND IC6 IS A MC1495CP

Figure 7-26. Assembly A5, Control Logic Schematic Diagram, Model 438A Only.

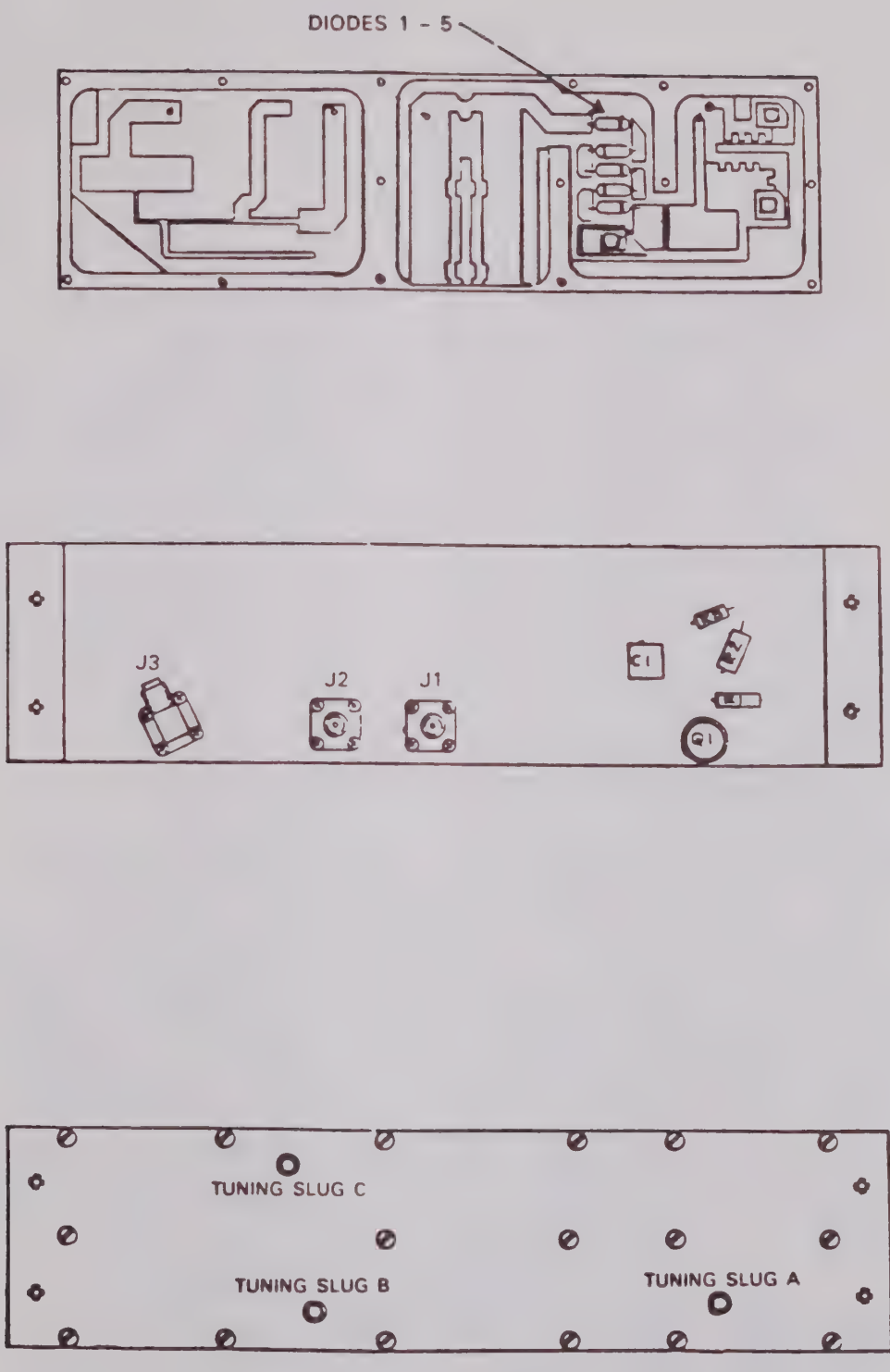


Figure 7-27. Assembly A8. Fixed Oscillator - Filter Component Identification (Model 438A Only)

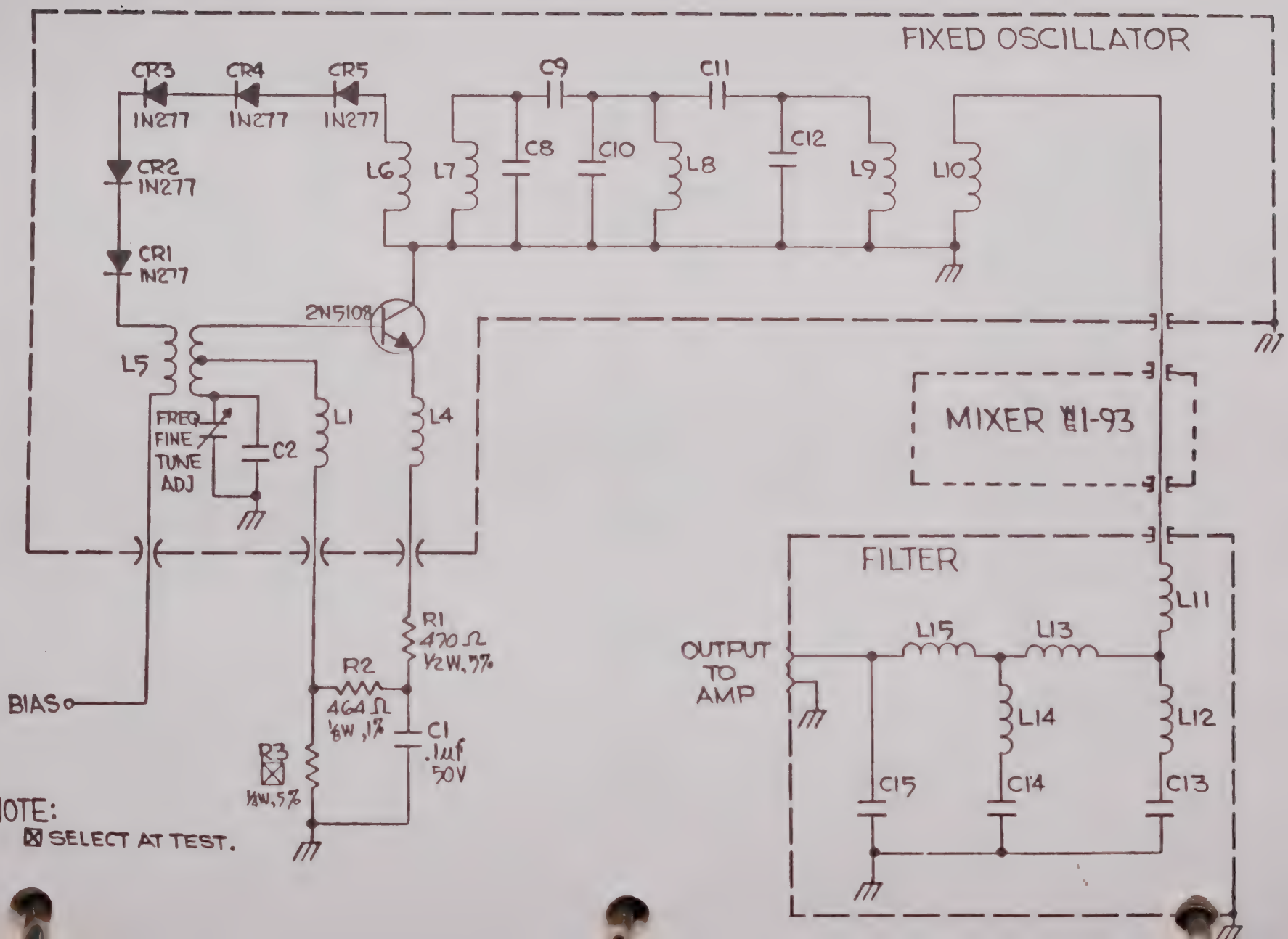
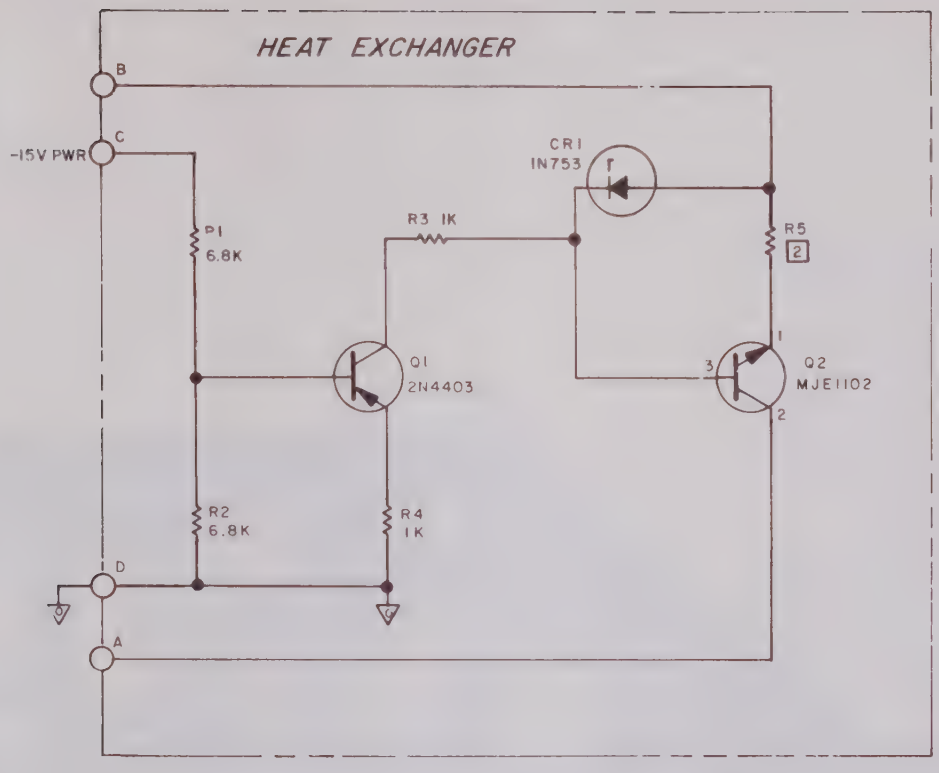
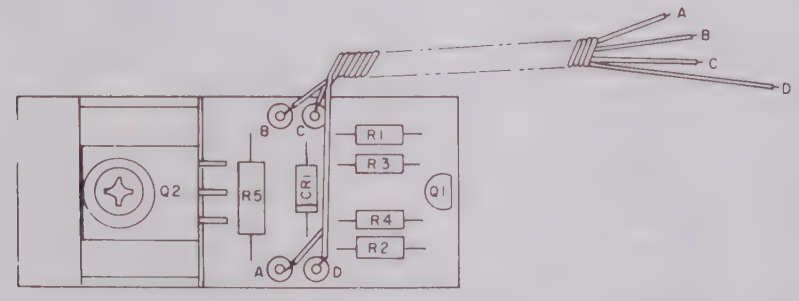


Figure 7-28. Assembly A8, Fixed Oscillator - Filter Schematic Diagram (Model 438A only)





SYM. DES.

1. CR DIODE
2. SOLDER TERM.

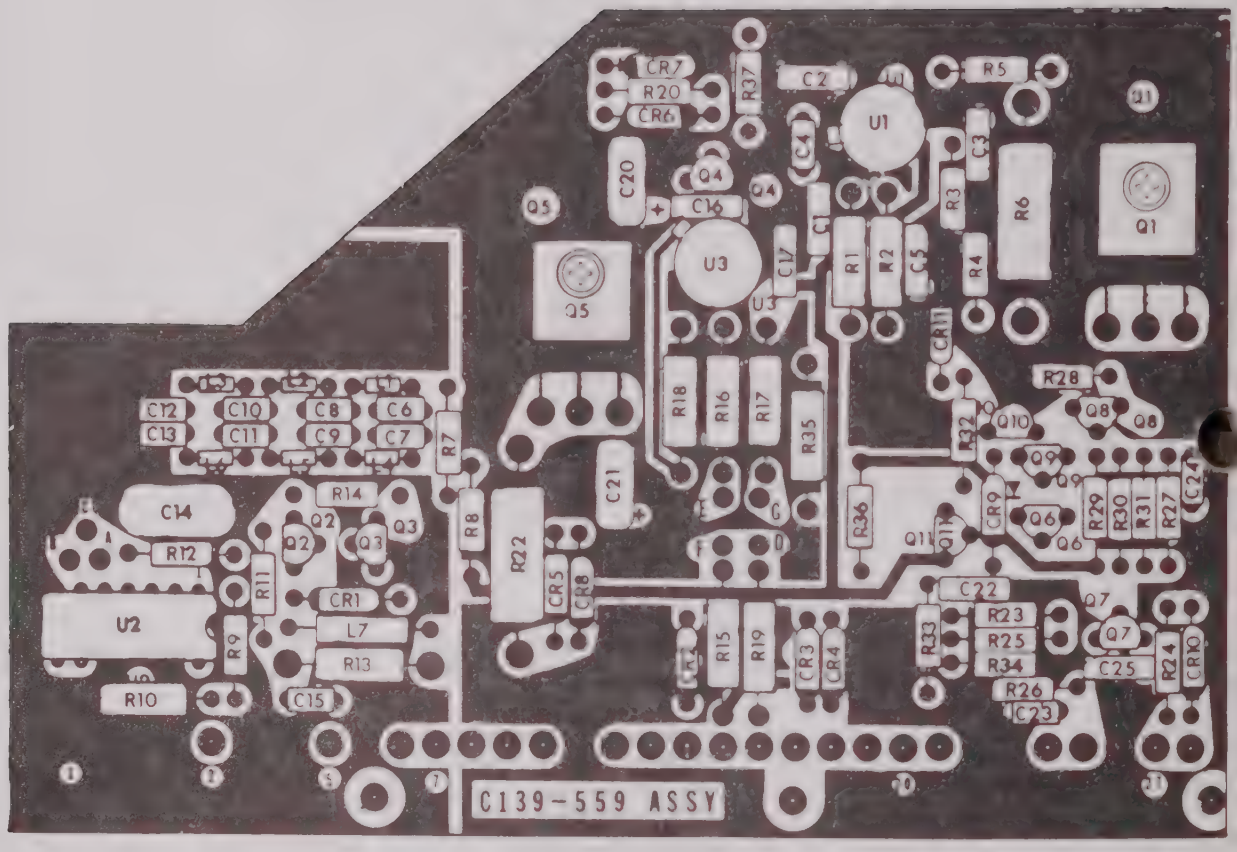
COLOR	WIRE	FROM	TO
W/RED	A	PIN A	Q2 AND A2-29
BLUE	B	PIN B	A2-51
VIO	C	PIN C	P1-31 (-15V)
BLACK	D	PIN D	GROUND

NOTE:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/4W, 5%

[2] SEE SPECIFIC PARTS LIST FOR VALUE AND USAGE.

Figure 7-29. Assembly A11 Heat Exchanger, Schematic Diagram and Component Identification, All Models Except 438A



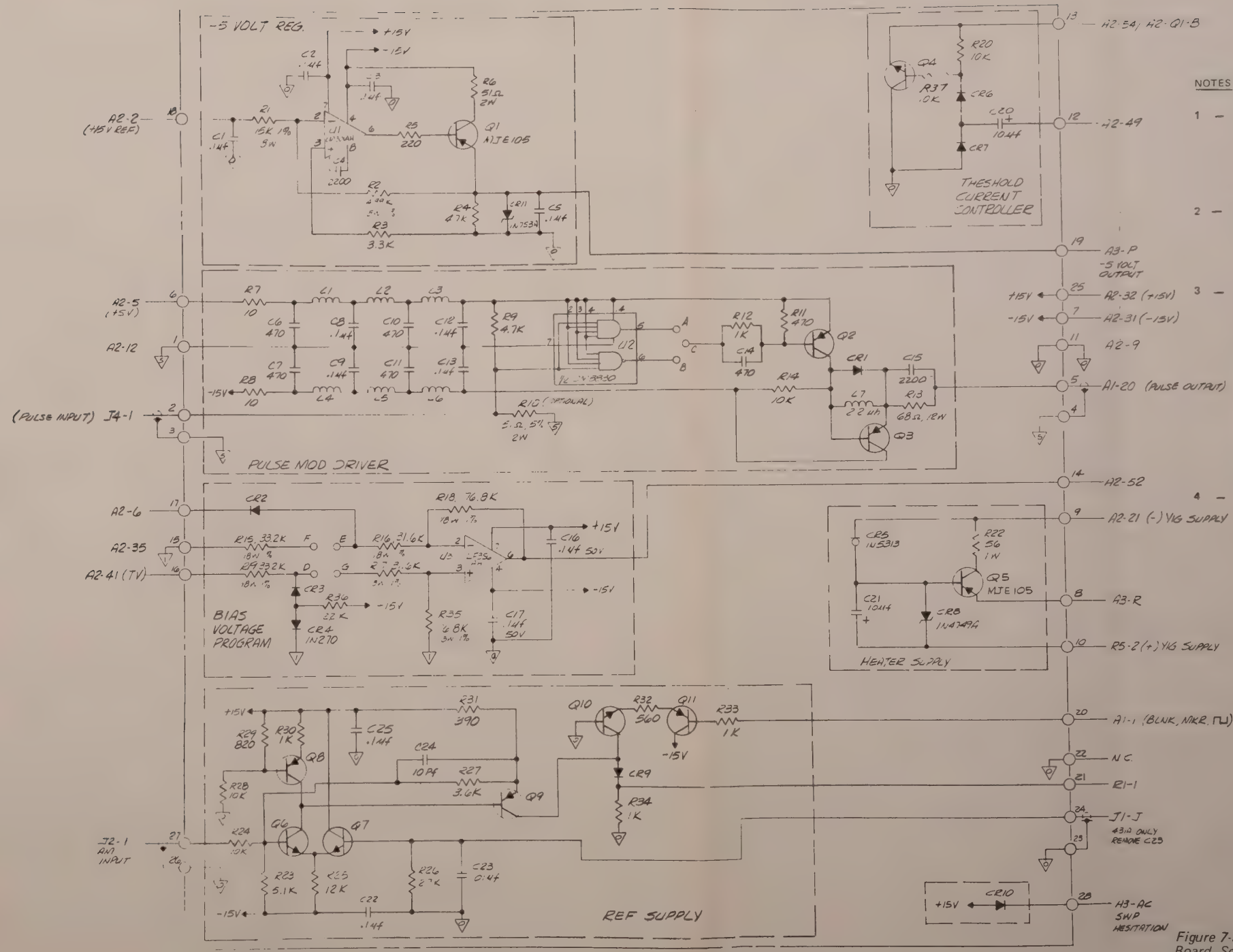
For models 431A, 432A, 433A & 442A use jumpers 'D' to 'E' & 'F' to 'G'
For models 434A, 435A/4309A, 436A & 444A use 'D' to 'G' & 'F' to 'E'

For standard option -03, +5V on, 0 volts off, use jumper 'A' to 'C' for non-standard option -03, 0 volts on, +5 volts off use jumper 'B' to 'C'

Sweep Hesitation diode CR10 is not required for multiband operation. However, it is used if a RF head is installed in a 430A mainframe for troubleshooting purposes. CR10 is used on all units except 435A/4309

R34, not used with RF LEVEL control, used only with part no. 20-201 RF LEVEL control and is always used with 'B' options.

 Figure 7-30. Assembly A12 Auxiliary Board, Component Identification, All Models Except 438A



NOTES

1 — UNLESS OTHERWISE SPECIFIED ALL
RESISTORS ARE IN OHMS, ¼W, 5%
TRANSISTORS ARE NPN 2 N4401
PNP 2 N4403
CAPACITORS ARE IN Pf
DIODES ARE IN914

2 — FOR MODELS 431A, 432A, 433A & 442A USE
JUMPERS D TO E & F TO G
FOR MODELS 434A, 435A, 435A/4309A,
436A & 444A USE
JUMPERS 'D' TO 'G' & 'F' TO 'E'

3 — CIRCUITS REQUIRED FOR VARIOUS
SOURCES ARE AS FOLLOWS:

MODEL	USAGE
431A(AV)	HEATER & R.S.
432A (AV)	HEATER, B.V.P & R.S.
433A (AV)	HEATER, B.V.P, -5 VREG & R.S.
434A (WJ)(VA)	B.V.P., T.C.C. & R.S.
434A (AV)	HEATER & R.S.
435A (VA)(WJ)	B.V.P., T.C.C. & R.S.
435A/4309A (VA)(WJ)	B.V.P. & T.C.C.
436A (VA)	B.V.P., T.C.C. & R.S.
442A (AV)	HEATER, B.V.P. & R.S.
444A (VA)	B.V.P., T.C.C. & R.S.

4 — [ ] DENOTES COMPONENTS REQUIRED TO ASSEMBLE EACH SEPARATE CIRCUIT.

Figure 7-31. Assembly A12 Auxiliary Board, Schematic Diagram, All Models Except 438A

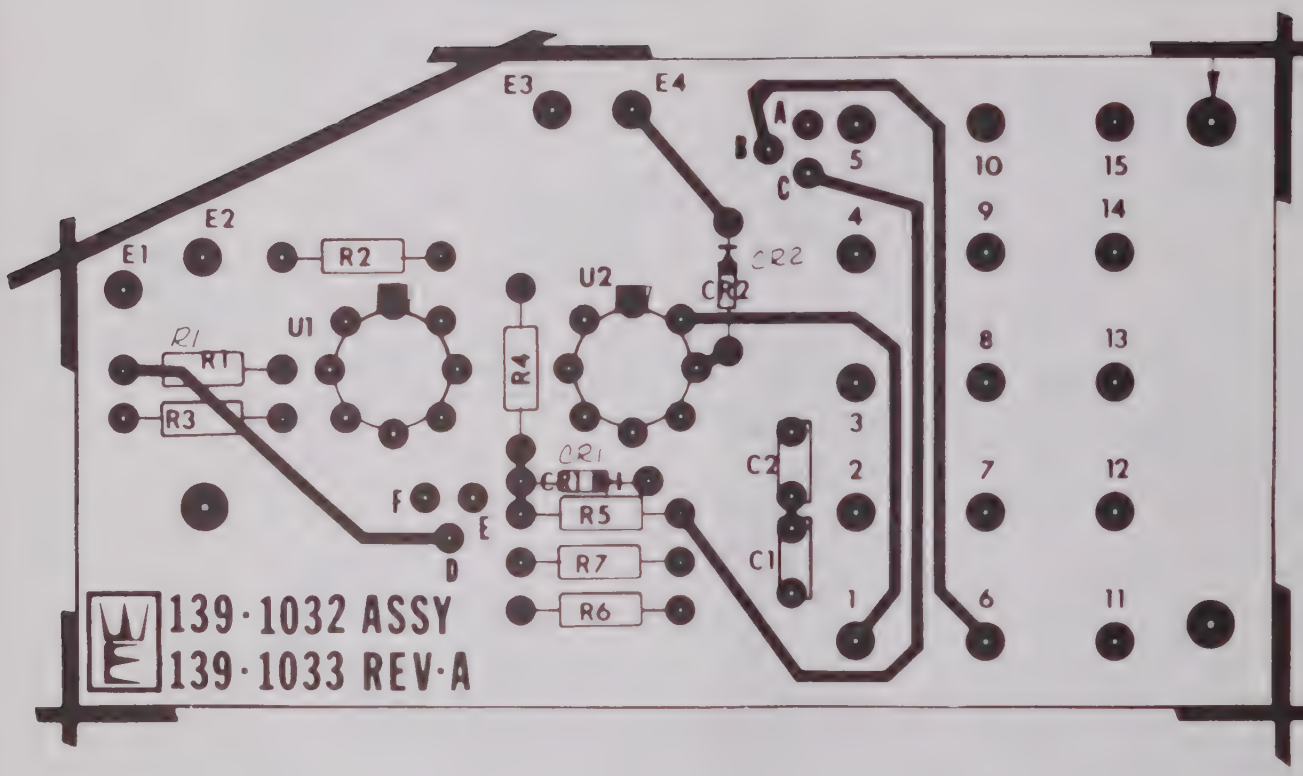


Figure 7-32. Assembly A13 Linearity and Auxiliary Circuit, Component Identification (Model 435A/4309A Only, Serial No. 1994 and Up)

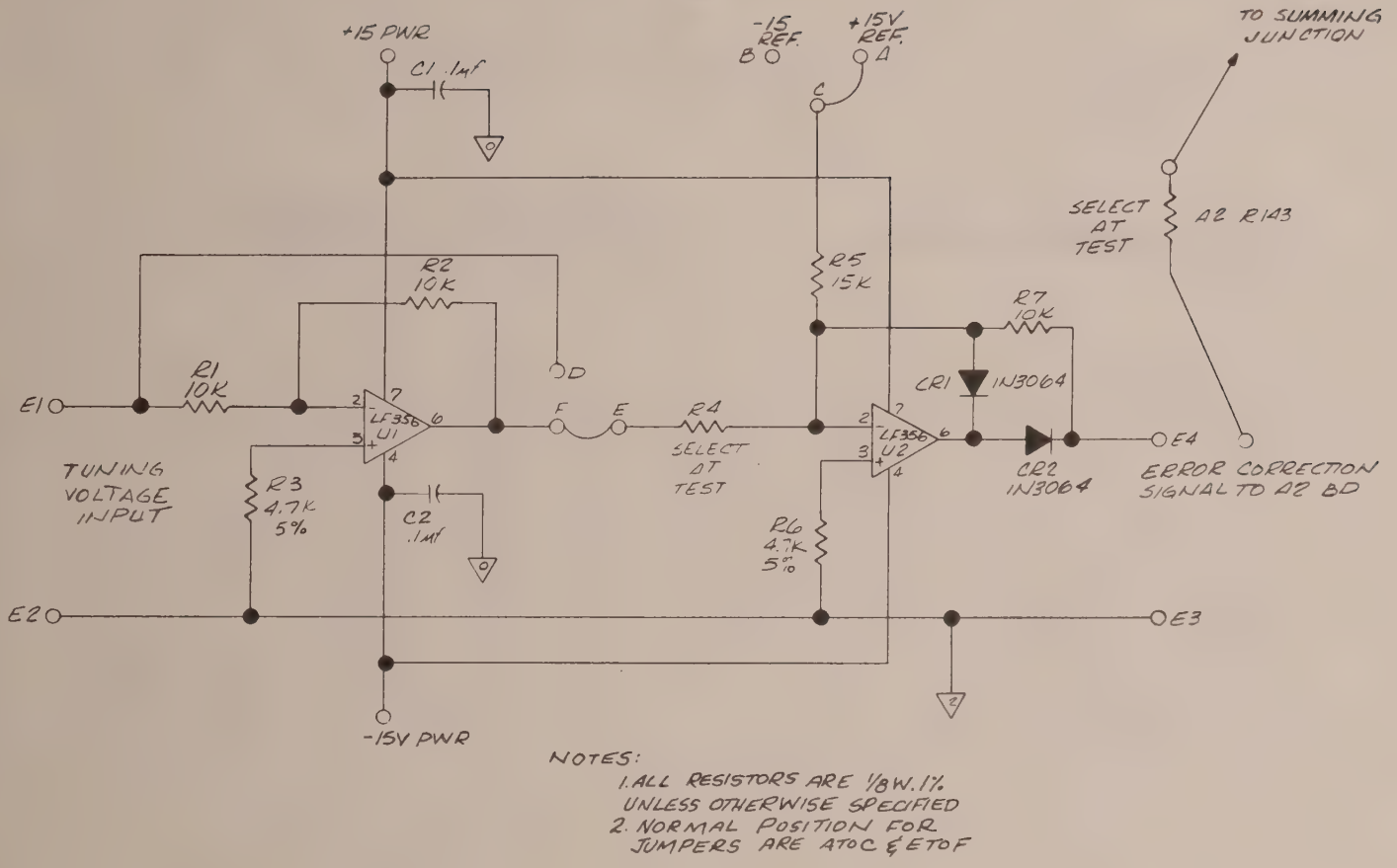


Figure 7-33. Assembly A13 Linearity and Auxiliary Circuit, Schematic Diagram (Model 435A/4309A Only, Serial No. 1994 and Up)

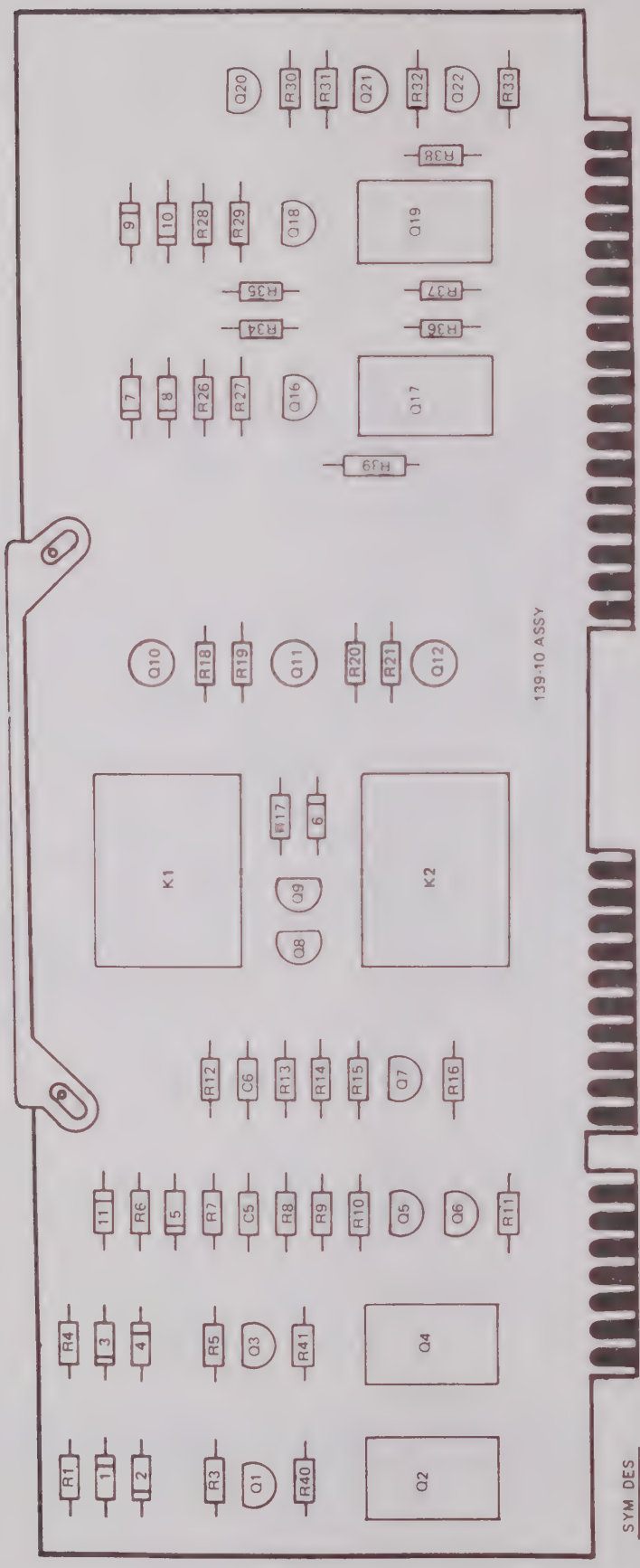
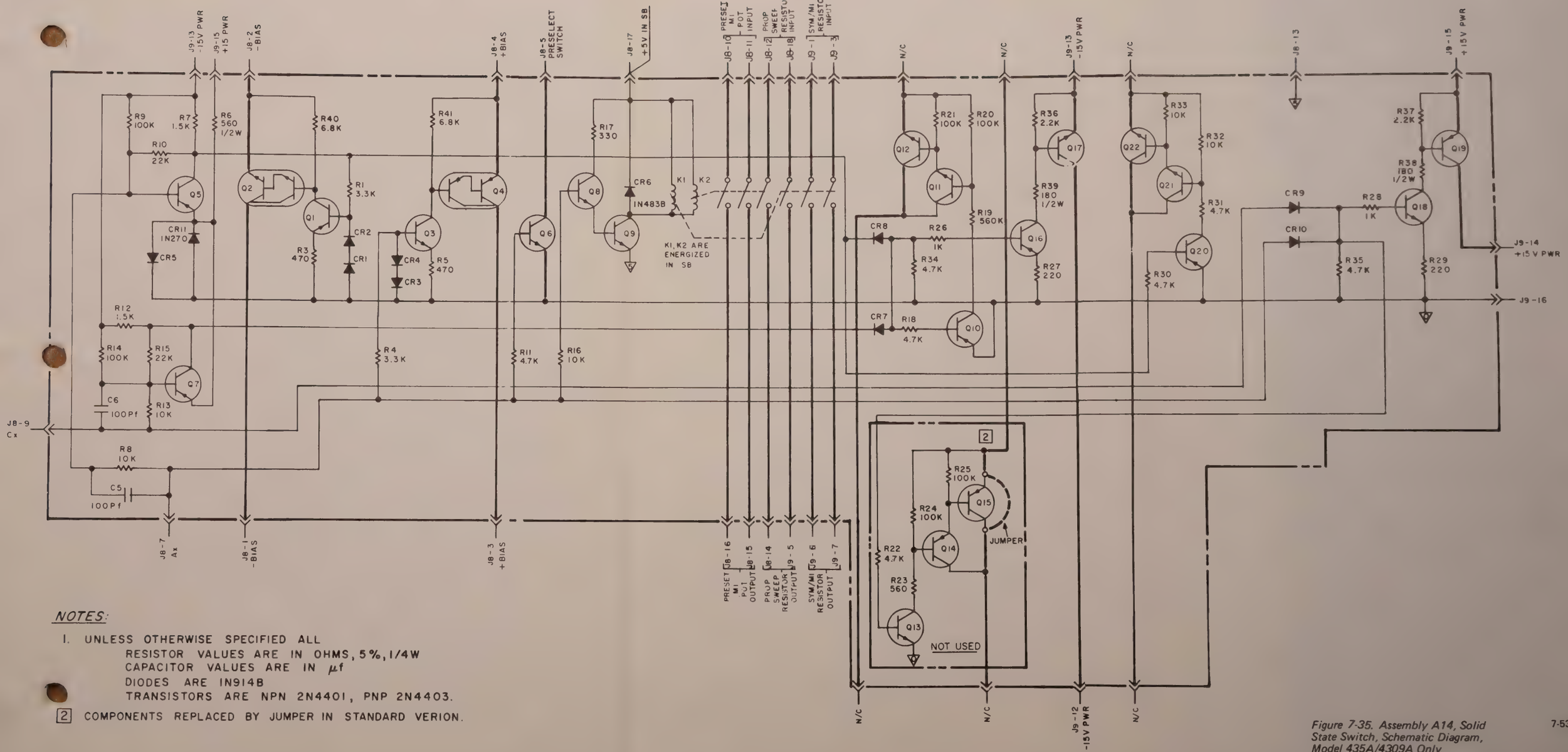


Figure 7-34. Assembly A14 Solid State Switch Assembly, Component Identification, Model 435A/4309A Only

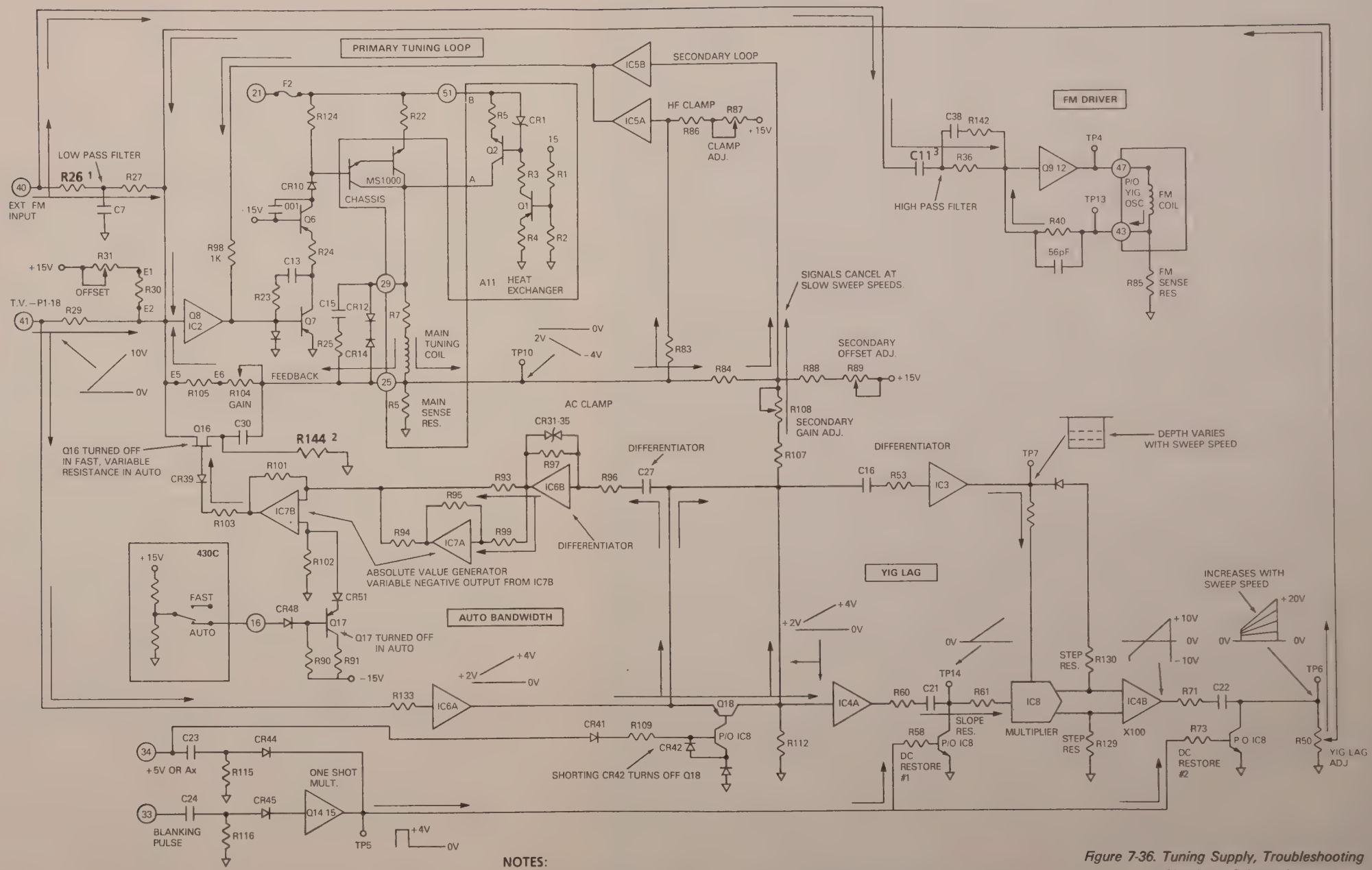


NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL
   RESISTOR VALUES ARE IN OHMS, 5%, 1/4W
   CAPACITOR VALUES ARE IN μf
   DIODES ARE IN914B
   TRANSISTORS ARE NPN 2N4401, PNP 2N4403.

[2] COMPONENTS REPLACED BY JUMPER IN STANDARD VERION.

Figure 7-35. Assembly A14, Solid State Switch, Schematic Diagram, Model 435A/4309A Only



NOTES:

1 R26 NOT USED ON MODELS 431A432A, 433A, 434A, 435A,435A/4309A AND 438A.

2 R144 NOT USED ON MODESL 436A, 437A AND 442A.

3 C11 NOT USED ON MODELS 431A, 432A, 433A, 434A, 435A, 435A/4309A AND 438A. INSTALL JUMPER.

Figure 7-36. Tuning Supply, Troubleshooting Simplified Schematic

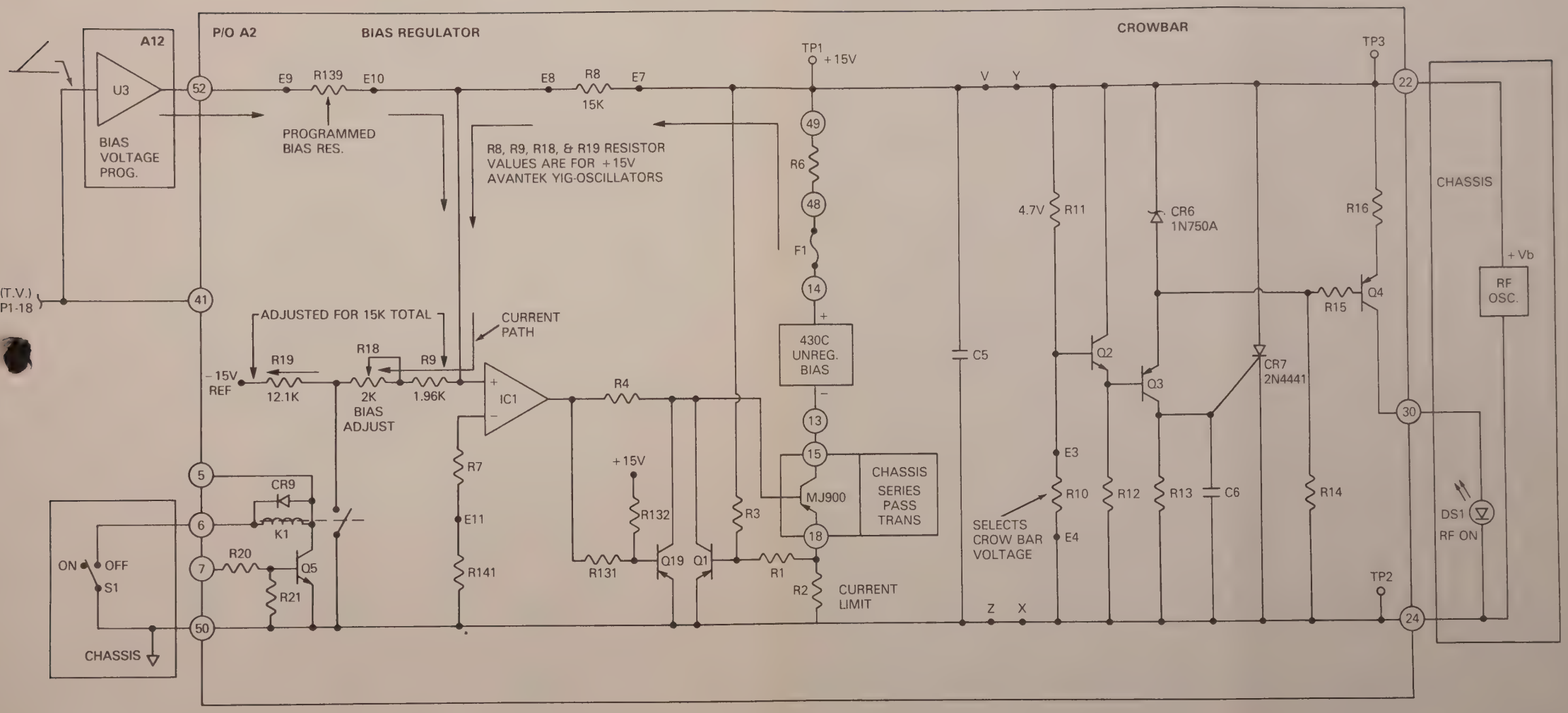


Figure 7-37. YIG bias, Troubleshooting Simplified Schematic

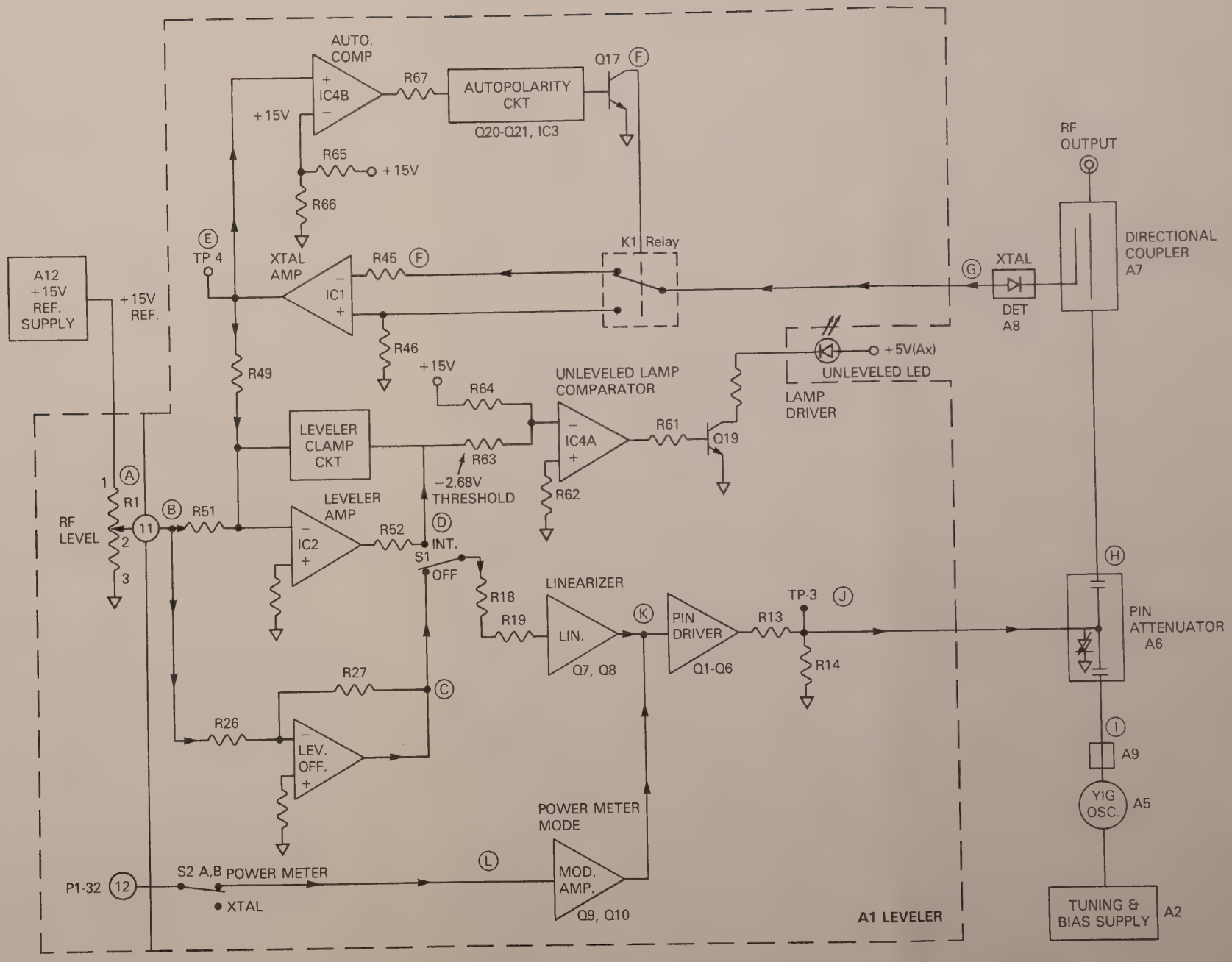


Figure 7-38. Leveling, Troubleshooting Simplified Schematic

MANUAL SUPPLEMENT NO. 2

MANUAL TITLE: OPERATION AND SERVICE MANUAL
MODELS
431A,432A,433A,434A,435A,436A
438A,442A,444A, and 435A/4309A
RE UNITS

MANUAL DATE: November 1979

SUPPLEMENT NO. 2: APRIL 1980

SUPPLEMENT NO. 2 APPLICABILITY: 431A, 433A, and 434A RF Units

Corrections to the manual are identified as ERRATA.

Improvements and modifications are identified as CHANGES

CHANGES:

Due to the output characteristics of some RF Sources, an additional assembly has been added to some 431A, 433A, and 434A RF Units. This assembly can be either a 3M- series Attenuator or a Low-Pass Filter. Table S2-1 identifies those RF Sources which may require an additional Attenuator. Table S2-2 identifies the RF Sources which may require a Low-Pass Filter.

In model 431A- series RF Units, the additional assembly would be an Attenuator located after the RF Source (A5) in the signal path. In the model 433A-series RF Units the assembly can be either an Attenuator or a Low-Pass Filter, depending on the RF Source, located after the Isolator Assy. (A9), in the signal path. In the 434A- series RF Units, the assembly would be a Low-Pass Filter located after the Isolator Assy.

Table S2-1. RF Sources with Attenuators

Freq. Range	WE Part No.	Mfg. Part No.	Attenuator Model No.
1-2 GHz	16-95-1	ASF-9654M	3M-2 (2dB) or 3M-3 (3dB)
4-8 GHz	16-144-1	S09-1358M	as required

The Attenuators are 2dB or 3dB models of the 3M series. These are 50- ohm type with 2 watt avg. power capacity and maximum deviation of ±0.3 dB.

Table S2-2. RF Sources with Low-Pass Filters

Freq. Range	WE Part No.	Mfr. Part No.	WE Filter Part No.
4-8 GHz	16-139	S09-0487M	1-118-3
4-8 GHz	16-135	S09-0267M	1-118-3
8-12.4 GHz	16-115	SF7-1240M	1-108-5
8-12.4 GHz	16-140	S09-0488M	1-108-5

APPENDIX X
CARE AND HANDLING OF MICROWAVE COAXIAL CABLE ASSEMBLIES

X-1. CARE AND HANDLING OF ASSEMBLIES

To ensure accurate measurements and optimal performance of Weinschel Engineering products, the microwave coaxial cable assemblies used in system and test setups must be properly used and maintained. Proper connections, routine inspection of all cables, and cleaning of the connectors are extremely important procedures which can prolong the longevity and accuracy of equipment.

X-2. MAKING INITIAL CONNECTIONS

Exercise caution when mating cables. Poor connections lead to poor system performance. They can also damage not only the cable assembly, but more significantly, front or rear panel connectors on the equipment itself which may be more difficult to repair.

GNING CONNECTORS

Align the center lines of two connectors before actual mating. Male retaining nuts contain a small amount of necessary play which may make it possible to mate the threads without the pins being properly aligned. Pin misalignment can damage pins and dielectric inserts.

MATING CONNECTORS

Gently mate the connectors by hand, taking care not to force the coupling nut at the slightest resistance. It is often possible to *feel* whether or not the pins are mated. If the coupling nut is difficult to turn, either the pins are not mated, the coupling nut is cross-threaded, or one of the connectors has been damaged by excess torque.

Never hold a male connector coupling nut stationary while screwing a female connector into it. This rotation can erode the plating and damage both the outer interface rim as well as the pin. If the pins become locked, serious damage can result to both the equipment and the cable assembly.

X-3. ENSURING PROPER CONNECTOR TORQUE

OVERTORQUING

Once connectors have been properly mated, apply only the proper amount of torque. Overtorquing damages both connectors involved. Also, a connector which has been damaged by overtorquing, in turn, damages every connector to which it is subsequently mated. It usually

leads to poor system performance as well. Overtorque can cause:

- Bent pins
- Recessed or protruding pins
- Recessed or protruding dielectrics
- Chipped plating
- Damaged coupling threads
- Coupling nut retaining ring damage
- Mushroomed outer interface shells
- Mushroomed pin shoulders

HEX-NUT TYPES

To mate a connector of the hex-nut type, always use a torque wrench set to the correct torque value. Tighten the connector slowly until the wrench *snaps*. Tightening too quickly can cause the wrench to exceed its set limit. Do not snap the wrench more than once as this also causes overtorque.

KNURLED NUTS

Tighten connectors with knurled nuts by hand. If this does not provide sufficient tightness use a hex-nut connector and torque wrench instead. *Never use pliers to tighten a connector.*

X-4. PROPER CABLE HANDLING

Never exceed the minimum bend radius specified for a cable. Guard against tight bends at the end of connector strain relief tubing, or at the ends of marker tubing where they may be less noticeable. Although cable bend may seem slight, the actual radius of the bend at the point of angular departure may be far smaller than the acceptable radius.

Never pinch, crush or drop objects on cable assemblies. Also, do not drag a cable over sharp edges as this will pinch it and cause it to exceed the minimum bend radius.

Never use a cable assembly to pull a piece of equipment. Cables and connectors are not designed to support or move equipment.

SECURING CABLES

Use toothed, rubber-lined "P-clamps" to hold cables in place. If it is necessary to use tie-wraps, use the widest possible wrap and the lowest setting on the gun to ensure the minimum pressure on the cable.

STORING CABLES

When storing cables, minimize cable "set" by coiling them in large diameters (1 or 2 feet). Unroll the cable properly when it is ready to be used; do not pull the loops out hastily. Similarly, re-roll them when storing them away again.

X-5. CABLE INSPECTION

Routinely check external cables for signs of cracked insulation, dents, twists, flattening, signs of jacket abrasion, or other signs of abuse. Wrinkles in the jacket indicate that the minimum bend radius has been exceeded. Most often, this occurs near the marker tubes and connectors.

Also inspect the connector interfaces for the following:

- Bent pins (male)
- Bent or missing tines (female)
- Worn or chipped plating
- Damaged or displaced dielectric inserts
- Thread damage
- Folded or mushroomed outer interface rims
- Mushroomed pin shoulders (male) or tine ends (female)
- Score lines on pins and outer interface rims visible to the unaided eye
- Recessed or protruding pins

It is advisable to clean the connectors prior to inspection to make subtle damage more apparent. If any of the above is noted, replace the assembly before its further use results in equipment damage. Also inspect the mating connectors for similar damage.

Inspect the connector interface for signs of debris. Debris may be in the form of:

- Plating chips or other metal particles
- Dust or dirt
- Oily films
- Other miscellaneous foreign particles

If signs of debris are present, clean the connector interface as directed in Paragraph X-6.

X-6. CLEANING CONNECTOR INTERFACES

Use the following guidelines in cleaning connector interfaces:

A. Do not use chlorinated solvents including common tap water. These solvents are extremely penetrating and sometimes ruin otherwise good devices and assemblies.

B. Moisten a cotton swab with isopropyl alcohol. Roll the swab on a paper towel to remove excess.

C. Use the moistened cotton swab to wipe away debris. Do not try to dissolve the debris by overwetting the swab.

D. Repeat the cleaning process using additional swabs as necessary. If metallic particles are embedded in the dielectric, use an eyeglass and a sharp pick in an attempt to dislodge them. Swab again.

E. When satisfied that the interfaces are clean, blow them dry with dry compressed air, or preferably dry nitrogen (pressurized spray cans work well). Do not use breath.

F. Clean the mating connectors. These may be the source of the debris.

PARTS LIST, ASSEMBLY DRAWINGS AND SCHEMATIC DIAGRAM REVISION LEVELS

Drawing No.	Title	Fig. No.	Rev.	Table No.	Rev.
---------	RF Cables/Connectors			6-24	
---------	Leveller Board, Assy. A1, Quick Disconnect Lead and Pin Location Diagram	7-12			
---------	Yig-Tuned RF Unit with A3 Board, without Reference Supply, Schematic	7-2			
SK2609	Symmetrical Sweep Switch, Assy. A4, Model 444A, Component Location	7-24		6-16	
SK3265	Symmetrical Sweep Switch, Assy. A4, Model 436A, Component Location	7-24		6-14	
139-10	Solid State Switch, Assy. A14, Model 435A/4309A, Component Location	7-34	H	6-23	L
139-109	Tuning and Bias Supply, Assy. A2, all models at Rev. F, Component Location	7-14	F		
139-109	Tuning and Bias Supply, Assy. A2, all models at Rev. G, Component Location	7-15	G		
139-109	Tuning and Bias Supply, Assy. A2, Ser. No. 1994 and above, Component Location	7-16	R	6-6	---
139-109-XX	Bias Tuning Voltage Transistor Type and Jumper Placement	7-17	---		
139-109-12	Tuning and Bias Supply, Assy. A2, Models 435A and 435A/4309A, Parts List			6-6E	G
139-109-15	Tuning and Bias Supply, Assy. A2, Model 433A, Parts List			6-6C	H
139-109-19	Tuning and Bias Supply, Assy. A2, Model 438A, Parts List			6-6G	H
139-109-20	Tuning and Bias Supply, Assy. A2, Model 431A, Parts List			6-6A	G
139-109-21	Tuning and Bias Supply, Assy. A2, Model 432A, Parts List			6-6B	G
139-109-23	Tuning and Bias Supply, Assy. A2, Model 434A, Parts List			6-6D	F
139-109-26	Tuning and Bias Supply, Assy. A2, Model 444A, Parts List			6-6I	---
139-109-27	Tuning and Bias Supply, Assy. A2, Models 435A and 45A/4309A, Rev. L and above, Parts List			6-6E	E
139-109-28	Tuning and Bias Supply, Assy. A2, Model 436A, Parts List			6-6F	B
139-109-29	Tuning and Bias Supply, Assy. A2, Model 442A, Parts List			6-6H	A
139-168-1	Leveller Bd., Assy. A1, 438A only, Component Location	7-11	G	6-5B	M
139-168-2	Leveller Bd., Assy. A1, all models except 438A, Component Location	7-11	G	6-5A	M
139-199	Symmetrical Sweep Switch, Assy. A4, Models 431A, 438A, Component Location	7-24	A	6-9	---

PARTS LIST, ASSEMBLY DRAWINGS AND SCHEMATIC DIAGRAM REVISION LEVELS

Drawing No.	Title	Fig. No. Rev.		Table No. Rev.	
139-200	Symmetrical Sweep Switch, Assy. A4, Model 432A, Component Location	7-24	A	6-10	---
139-202	Symmetrical Sweep Switch, Assy. A4, Model 434A, Component Location	7-24	A	6-13	---
139-264	Auxiliary Reference Supply, Assy. A3, all models except 438A and 435A/4309A, Schematic	7-22	OBS		
139-265	Yig Bias and Tuning Supply, Assy. A2, Ser. Nos. below 1994, Schematic	7-19	OBS		
139-266	Leveller Bd., Assy A1, all models except 438A, Schematic	7-13	E		
139-266	Levelling Board, Assy. A1, Troubleshooting Simplified Schematic	7-38	E		
139-275	Symmetrical Sweep Switch, Assy. A4, Model 442A, Component Location	7-24	---	6-15	---
139-316-1	Heat Exchanger, Assy. A11, Models 434A, 436A, 444A, Component Location and Schematic	7-29	F	6-19	C
139-316-2	Heat Exchanger, Assy. A11, Models 435A, 435A/4309A, Component Location and Schematic	7-29	F	6-20	C
139-333	Solid State Switch, Assy. A14, Model 435A/4309A only, Schematic	7-35	J		
139-337	Model 438A Yig-Tuned RF Unit Assy., Schematic	7-6	C(OBS)		
139-337	Fixed Oscillator/Filter, Assy. A8, Model 438A only, Schematic	7-28	C(OBS)		
139-459	Control Logic, Assy. A5, Model 438A, Component Location	7-25	G	6-17	M
139-476-1	Heater Board, Assy. A3, 438A only, Componet Location	7-23	A	6-8	B
139-482-1	Fixed Oscillator/Filter, Assy. A8, Component Location	7-27	C	6-18	D
139-559	Auxiliary Board, all models except 438A, Component Location	7-30	H	6-21	K
139-560	Auxiliary Board, Assy. A12, all models except 438A, Schematic	7-31	J		
139-625	Model 438A Yig-Tuned RF Unit Assy., Component Location	7-4	---	6-4B	F
139-788	Symmetrical Sweep Switch, Assy. A4, Model 433A, Component Location	7-24	A	6-11	A
139-789	Symmetrical Sweep Switch, Assy. A4, Model 434A, Component Location	7-24	A	6-12	B
139-800	Basic Chassis Assy., all models except 438A	7-1	B	6-4A	B
139-802	Yig-Tuned RF Unit Assy., all models except 438A and 435A/4309A, Component Location	7-1	A	6-4A	E
139-809	Yig Bias and Tuning Supply, Assy. A2, Ser. Nos. 1994 and above, Schematic	7-18	E		
139-809	Tuning Supply, Assy. A2, Troubleshooting Simplified Schematic	7-36	E		
139-809	Yig Bias, Assy. A2, Troubleshooting Simplified Schematic	7-37	E		

PARTS LIST, ASSEMBLY DRAWINGS AND SCHEMATIC DIAGRAM REVISION LEVELS

Drawing No.	Title	Fig. No. Rev.		Table No. Rev.	
139-814	Auxiliary Termination Board, Assy. A3, all models except 438A, 435A/4309A, Component Location	7-21	B	6-7	A
139-854	Auxiliary Board, Assy. A3, Wiring Diagram	7-20	A		
139-895	Basic Chassis Assy., all models except 438A			6-4A	C
139-938	Control Logic, Assy. A5, Model 438A only, Schematic	7-26	F		
139-944	Basic Chassis Assy., all models except 438A			6-4A	C
139-945	Basic Chassis Assy., all models except 438A			6-4A	D
139-946	Basic Chassis Assy., all models except 438A			6-4A	F
139-954	Basic Chassis Assy., all models except 438A			6-4A	A
139-1032	Linearity and Auxiliary Board, Model 435A/4309A, Ser. Nos. 1994 and above, Component Location	7-32	A	6-22	A
139-1062	Model 435A/4309A Interface Unit, Ser. Nos. 1994 and above, Component Location	7-7	B	6-4A	C
139-1062	Model 435A/4309A Interface Unit, Ser. Nos. below 1994, Component Location	7-8	A		
139-1064	Yig-Tuned RF Unit Assy., all models except 438A and 435A/4309A, Component Location	7-1	A	6-4A	C
139-1069	Linearity and Auxiliary Circuit, Assy. A13, Model 435A/4309A, Ser. No. 1994 and above, Schematic	7-33	A		
139-1072	Model 435A/4309A Interface Unit, Ser. Nos. 1994 and above, Schematic	7-9	B		
139-1072	Model 435A/4309A Interface Unit, Ser. Nos. below 1994, Schematic	7-10	A		
139-1095	Model 438A RF Cable Interconnection Diagram	7-5	A		

MODELS 431A, 432A, 433A, 434A, 435A, 436A, 438A, 442A, 444A, AND 435A/4309A RF UNITS (IM-101)

REVISION RECORD

REVISION	DATE	DESCRIPTION
A	11/79	Initial issue.
B	11/80	
C	8/83	
D	1/86	Incorporates ECN 85-201 and previous.